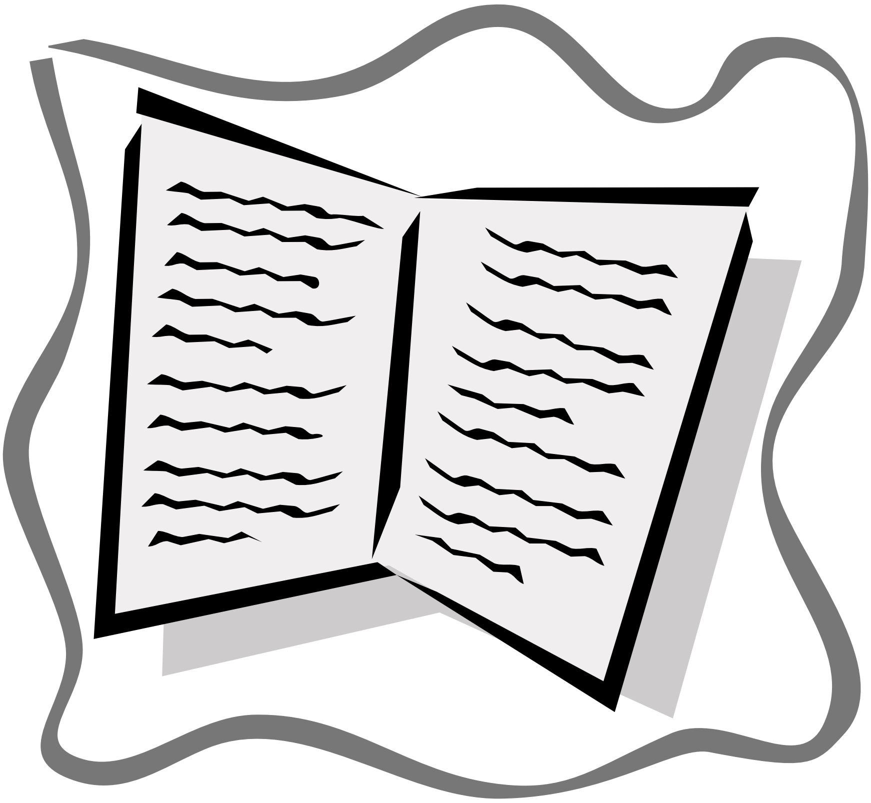
LITERACY

TEACHING LITERACY IN MATHEMATICS IN YEAR 7

NEW SOUTH WALES
DEPARTMENT
OF SCHOOL
EDUCATION



Teaching literacy in mathematics in Year 7

NEW SOUTH WALES DEPARTMENT OF EDUCATION AND TRAINING | Curriculum K-12 | NEALS

NEALS

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Chapter 1: The literacy demands of mathematics

> *I was made to learn by heart: "The square of the sum of two numbers is equal to the sum of their squares increased by twice their product". I had not the vaguest idea what this meant, and when I could not remember the words, my tutor threw the book at my head, which did not stimulate my intellect in any way.*
>
> (Bertrand Russell, *Autobiography*, 1986, p. 34)

In a Year 7 class learning about directed numbers, the following discussion unfolds:

Teacher: You will remember yesterday when we started to look at numbers that showed direction. Who can tell me how we would show a loss of $40 as a directed number?

Student 1: Take away $40.

Teacher: Yes… We could say *minus $40* to remind us of the operation but to record this as a number we say *negative 40*. How could we write this as a number?

Student 2: With a minus sign in front of the 40.

Teacher: (*Teacher writes -40 on the board.*) We say that directed numbers have both size (*points to the 40*) and direction (*points to the - sign*).

Teacher: How would we show a change of temperature if the temperature fell from 37° to 26°? (*Writes question on the board and underlines "from" and "to".*)

In this brief transcript we can see that the teacher is providing *scaffolding* for the students' learning in a number of ways:

- The teacher makes links with and activates prior learning.
- The teacher provides explicit teaching of the subject-specific vocabulary and moves the students from their commonsense understandings of the topic to the technical understandings required.
- The teacher provides a visual model of the structure of the language of the question.

Students need explicit instruction to enable them to read, write and interpret basic mathematical symbols and prose with confidence. Words in mathematics that have different meanings in everyday language often confuse students. Where words have mathematical and non-mathematical meanings, students should know both and be able to interpret the meaning correctly in the appropriate context. For example: In everyday use the word "table" refers to a piece of furniture. In mathematics the meaning is quite different. Similarly, the word "leaves" most often refers to parts of a plant as a noun or frequently as a verb means "departs". In the mathematics statement "eight minus six leaves two" the meaning is different again.

- This book will highlight the explicit and systematic teaching of the literacy demands of mathematics so that the teaching of content is not impeded by students' lack of ability to read and write appropriately or to use mathematical langauge.

Definition of literacy

Literacy is the ability to read and use written information and to write appropriately, in a range of contexts. It is used to develop knowledge and understanding, to achieve personal growth and to function effectively in our society. Literacy also includes the recognition of numbers and basic mathematical signs and symbols within text.

Literacy involves the integration of speaking, listening and critical thinking with reading and writing. Effective literacy is intrinsically purposeful, flexible and dynamic and continues to develop through an individual's lifetime.

All Australians need to have effective literacy in English, not only for their personal benefit and welfare, but also for Australia to reach its social and economic goals.

Australia's Language and Literacy Policy,
Companion Volume to Policy Paper, 1991, p.9.

Successful Year 7 students in mathematics need to demonstrate a variety of literacy skills in order to develop and convey their knowledge, skills and understandings of mathematics.

Talking

In studying mathematics students are expected to:

- discuss
- explain
- describe and
- argue a particular point of view (for example, justifying a strategy for solving a problem).

The learning of mathematics relies heavily on oral and written explanations. Working in small, collaborative groups, students can be given the opportunity to communicate orally, join in discussions constructively, and express ideas and opinions without dominating. This may help them to make the link between language and meaning.

By encouraging students to talk you can assess the link between the students' prior understandings of mathematics and the new concepts being introduced. Discussions between the teacher and students can also be beneficial as preparation for reading or writing activities, since they can assist in increasing students' understandings before undertaking the task. Requiring students to present a verbal report to the class provides an opportunity for students to choose an appropriate language form for the audience.

All lesson types in mathematics can support the development of literacy skills. Cooperative learning activities can be designed to focus on the acquisition of mathematical language and concepts.

The teaching of mathematical literacy is part of teaching mathematics.

Leaving out the words or avoiding the language has short-term benefits but ultimately doesn't work. We need to develop teaching strategies that address the specific mathematical language needs of our students.

Listening

When studying mathematics, students are expected to listen in order to gain information and follow instructions. This means students will have opportunities to ask questions (of the teacher and peers) to clarify meanings, respond positively to alternative viewpoints, and make brief notes based on a spoken text. While students are listening, the teacher could write on the board words that may cause difficulties for some students. Words that may be misinterpreted because of the similarity of their sounds include *ankle* for *angle*, and *size* for *sides*.

Reading

In studying mathematics students are expected to read to locate specific information, and understand concepts and procedures, as well as to interpret problems.

When reading familiar texts we often leave out words, change their order or even substitute words. Language is normally full of redundant information. This allows us to understand by skim reading or to gain meaning from the use of key words and contextual clues. Mathematics texts, however, are often lexically dense. This means that few words are used, all essential to the meaning. Consequently, as part of the literacy demands of mathematics, word order is very important. Consider the following two questions which contain exactly the same words:

- *Sixty is half of what number?*
- *Half of sixty is what number?*

Apparently otherwise insignificant small words such as *to, of* or *by* become vitally important for making sense in mathematics. Compare "increase *by* one-third" to "increase *to* one-third". Similarly, the description of change is often dependent on the use of prepositions:

- The temperature increased *to* 5 degrees.
- The temperature increased *by* 5 degrees.
- The temperature increased *from* 5 degrees.

The demands in processing such language are often far more complex than the underlying number facts suggest. The following question demonstrates this difficulty.

> *Mary is 35 years younger than Tom. Fred is half the age of Mary. Judy is 17 years older than Fred. If Judy is 35, how old is Tom?*
>
> McSeveny, A, Conway, R and Wilkes, S (1987) *Signpost Mathematics Year 7*, p.43.

Each sentence is short and compares the ages of two people. The comparisons are *younger than*, *half the age of* and *older than*. Beyond the use of three different comparisons, the order of reference of the people presented in pairs is intentionally designed to increase the difficulty of the question.

Students can use several strategies when reading difficult texts. These include talking to others about information in the text, re-reading parts of the question, making notes about key features, using diagrams which accompany the text or using diagrams to make sense of the text.

The order in which information is presented in language is often at odds with the order in which it is processed in mathematics. This mismatch occurs even with very simple questions such as "Take 6 from 12". **Weaker readers process information in the order in which it is encountered.** Even students fluent in everyday spoken English may still have problems with "The number 5 is 2 less than what number?". The *5*, *2* and *less* in that order suggest the answer is *3*. The way the words are put together (the syntax) produces a different result. The mental restructuring that is necessary to recover the meaning may overload a student's processing and memory capabilities. Students often give up and simply guess what to do with the numbers.

The structure of everyday language can affect the translation of a situation from natural language into an algebraic statement. This occurs in the well-known "students-and-professors problem":

> Write an equation to show that there are six times as many students as there are professors.

The common variable-reversal error, 6S=P, appears to stem from using a left-to-right translation of the problem statement. Literal translation aligned with the syntax results in an incorrect mathematical statement.

Confusion over the order for processing information in text may lead to inappropriate simplifying strategies. This is common with students attempting division questions. Not only is there no consistent left-to-right processing of meaning in English:

- What is 3 divided by 6?
- Divide 3 into 6.
- Divide 3 into 6 equal parts.

but this lack of 'order' is perpetuated by two different symbolic orders:

- $3 \div 6$
- $6\overline{)3}$.

Little wonder students create a rule of "always divide the small number into the big number".

"More" or "less"

Consider the following three questions, each of which involves the numbers 3 and 5, and uses the relation "more than":

- Which number is three more than five?
- Five is how many more than three?
- Five is three more than which number?

In the first question the *three* and *five* are separated by *more than* and the answer is the sum of 3 and 5. This agrees with a "key words" approach common in teaching that links the phrase *more than* to addition. A student applying this approach to the second and third questions would be surprised to find that the answers have changed!

A "key words" approach to address the literacy demands of mathematics may be counterproductive. Yet this approach is commonly used to attempt to overcome literacy problems. After all, *more than* sometimes does mean addition.

The problem *more* or *less* may be compounded by the incorrect use of *less*. According to most authorities, *fewer* applies to number and *less* applies to quantity.

> *One number is 7 more than a second number. Their sum is 13. What are the numbers?*
>
> McSeveny, A, Conway, R and Wilkes, S (1987) *Signpost Mathematics Year 7,* p. 275.

Contrary to the belief that mathematics makes less use of language than other subjects, you will see that mathematics has its own subject-specific language structures.

Writing

In mathematics students are expected to write when they answer questions, present proofs and to consolidate understanding.

Many forms of writing can be undertaken in mathematics, such as writing proofs and solving algebraic problems. As students write, they will decide when help is needed. They may then approach a friend for an idea, or a dictionary for the best word or spelling. They also re-read their work during writing to maintain meaning, change words and phrases, or check for errors.

It is useful for students to learn to emphasise those parts of the text or question that are causing them difficulties. This could include underlining, circling or highlighting words, and understanding why some words are written in bold, or in a different typeface. Encourage students to ask questions, so they can clarify and consolidate what they are learning.

You should also encourage activities which require discussion with others and which include making notes, lists or drawing diagrams. This allows students to apply the concepts they have learned and to reflect on their work.

Chapter 2: The continuum of literacy development

During their primary years students will have been involved in a wide range of literacy experiences in all subjects.

A functional view of language

In the Department of School Education all literacy activities are based on a functional view of language, which emphasises the way language is used to make meaning. This view of language looks at how language enables people to do things: to share information, to enquire, to express attitudes, to entertain, to argue, to have needs met, to reflect, to construct ideas, to order experience and to make sense of the world. It is concerned with how people use language for real purposes in a variety of social situations. All these language exchanges, whether spoken or written, formal or informal, are called "texts".

A functional view of language recognises the ways in which the particular language choices we make in any situation influence, and are influenced by, the people involved and the subject matter. The roles and relationships existing between the speaker and the listener or between the reader and the writer influence the words which will be used and the ways in which the text will be structured.

Similarly, the subject matter will influence the language choices. For example, in a text about how to construct a triangle you would expect to find language which instructs or commands, such as *mark, draw* and *measure*. You would expect to find words which name the equipment to be used, such as *compass* and *ruler*, and technical words which relate to mathematical concepts such as *arc, ray* and *segment*.

Primary school experiences

During their primary years students will have been engaged in talking, listening, reading and writing for a range of purposes. These purposes would have led them to become familiar with a variety of different forms of reading, writing, talking and listening. These different forms of language are often called *text types*. We can group them together, based on features they have in common, and give them names, such as *narrative, discussion, explanation, exposition, procedure, recount, report* and *response* or *review*.

Many of the tasks in which students will be involved during high school will require them to incorporate the features of several different text types.

Consider a task such as the following:

> *Find five different-sized food containers at home which each have a gross weight of 500 g. Describe these containers in terms of their shapes and measure the dimensions of the containers.*

This task requires students to examine real items, to locate information about them and then to write a description using correct mathematical vocabulary, such as *rectangular prism* and to create and label a diagram as a two-dimensional representation of the three-dimensional object. As well, they need to understand the specialised vocabulary of this task: *gross weight, 500 g, dimensions*. Students need support in recognising and completing all parts of the task. Interpreting the "language tag" for concepts such as *dimension* emphasises the interplay between subject content and language. Students should also be shown how to break up the task into its component parts.

1. *Find five different-sized food containers at home which each have a gross weight of 500 g* requires students to look at a number of ways of packaging food and locate information on them to determine their gross weight. Students may suggest such examples as margarine containers, cereal boxes and jars of coffee. Students would also need to know the difference between the terms *net weight* and *gross weight*. Indeed this pair of terms should be introduced together as their meanings are interdependent.
2. *Describe these containers in terms of their shapes* requires students to identify the solid which the container most closely resembles. You need to ensure that students understand what is required of them when the term *describe* is used. You could direct students either to draw a labelled diagram to present their information, or perhaps to describe their findings in prose form. The activity could be extended to include the names of the plane shapes that make up the solid, and perhaps incorporate the class information into a table, to find the most popular shape for packaging food.
3. *Measure the dimensions of the containers* requires students to use rulers, tape measures, callipers, depth gauges or other appropriate measuring instruments to determine the width, length and height of the containers. An understanding of the meaning of *dimensions* in this context is essential.
4. The question also implies that students should communicate the measurements in a particular way.

When setting tasks such as this you need to be clear about the purpose of the task, and what the students are expected to produce, and to articulate this clearly to the students. Make sure that students have previously been taught how to present information in the required ways. You should also make clear the criteria which will be used to evaluate their efforts.

Students' skills in using these text types have been developed in a range of key learning areas. Primary teachers tend to use an integrated model of teaching, where the boundaries between the various key learning areas are often blurred. For example a thematic unit of work in Year 6 on "space" might incorporate aspects of science, technology, HSIE, mathematics and English.

Within this unit of work students would have been speaking, listening, reading and writing for a number of purposes. They would have produced texts such as information reports, discussions, explanations and narratives. The implications of this teaching approach are that the students often do not recognise the key learning area or the content separate from the way of reading and writing. This means they sometimes have difficulty in transferring their learning from the primary to the secondary setting. For example, they may think that writing explanations is something they do when they write about “space” and not recognise that it is an appropriate form of writing in many different contexts.

Implications for teachers of mathematics in Year 7

As teachers we need to take account of the prior learning experiences of our students and make links to these experiences for them. This book provides a range of practical ways of addressing the learning needs of students.

In planning explicit support for students to meet the literacy demands of mathematics in the Year 7 curriculum, we also need to recognise that we are preparing our students for the further demands of stages 4,5 and 6.

When students arrive in Year 7 they have generally already learnt a great deal about mathematics in the areas of space, measurement and number, through interacting, investigating and using language. When students describe or write about what they are doing and thinking, they develop their own understandings and they can then communicate these understandings to the teacher. As students investigate and learn about mathematics, they need to use their own language to clarify their observations and to share their findings with others. Teachers need to assist students to develop more formal mathematics language as it is needed. (*Mathematics K-6 syllabus*, 1989.)

In primary school, the literacy demands of mathematics involve the use of oral and written language appropriate to the students’ particular stage of development in order for them to gain meaning from their mathematical learning experiences. The acquisition of mathematical language develops through the use of the four interrelated processes of talking, listening, reading and writing.

In high school, the literacy demands of mathematics expand and become more sophisticated. By Year 10, students focus on numerical, algebraic and graphical presentation of information. Students will need to develop a deep understanding of mathematics vocabulary and a facility in communicating their understanding to others. This understanding will allow them to use the mathematics terms meaningfully, both inside and outside school. (*Mathematics syllabus, Years 9 and 10*.)

For example:

> *A grocer buys vegetables wholesale and calculates the market price by increasing the cost by 60%. If the cost of a box of goods for the grocer is $300, find the marked price. How much profit will be made if the box of goods is sold at a 30% discount off the marked price? Find the maximum percentage discount the shopkeeper can offer without making a loss.*

This question relies heavily on students being able to extract the mathematics which has been embedded in the language. Encouraging students to discuss with each other what the components of the question actually mean and allowing them opportunities to share strategies with other class members will result in students having a shared responsibility for their learning. The practical applications of mathematics are often situated in specialised contexts. To decode the question to a level where the mathematical process skills can be used requires a sound understanding of the contextual concepts.

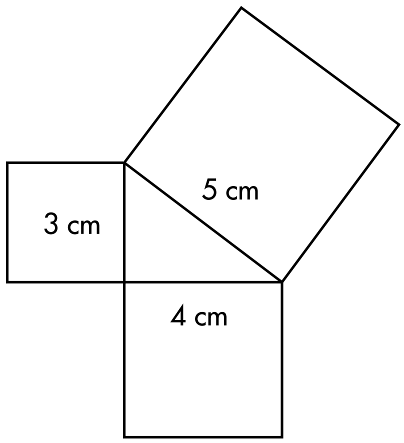
By Year 12, the students need to understand specialised and precise language if they are to achieve the objectives of their courses. The nature of proof and argument illustrates these mathematical text types. Constructing or decoding inductive proof, geometric proof, proof by contradiction or left hand side/right hand side proofs reflect the sophistication of literacy skills in senior mathematics.

Generally, students will not easily understand the more sophisticated literacy demands of mathematics in Years 7-10 unless we explain and explicitly teach these. Teachers need to be able to do this using a language to explain how language works in mathematics.

For example, consider the following theorem:

> *The square on the hypotenuse is equal to the sum of the squares on the other two sides.*

The language in this theorem is very condensed and complex. It needs to be "unpacked" if it is to have meaning for the student. The teacher is likely to draw a diagram of a right-angled triangle, build squares on each side, and then see if the students can see a relationship between the areas of the squares on the hypotenuse and the other two sides.



After involving the students in a number of examples, teachers will label the sides with pronumerals (say c for the hypotenuse, and a and b for the other sides) and then translate this written theorem into more accessible language such as: When we squared side a and added this to the square of side b, we noticed that this was the same as the square of side c.

The teacher can then link this verbal language to the written language to help students make sense of the theorem.

Supporting students as learners

Students learn about literacy as they interact with peers, teachers and the wider school community in a range of contexts. Students should have many opportunities to interact with others to express feelings and opinions and to listen and respond to the views of others. Students should be given opportunities to interact as readers or listeners with a wide variety of texts.

In all subjects, students develop understandings and learn new concepts and skills through the use of language. As they explore their environment, investigate problems and participate in cooperative learning activities, they use language to clarify their thinking, share and test ideas, communicate with others and reflect on their own learning.

Learning experiences should be designed to involve students in reading, writing, speaking and listening to a variety of texts which relate closely to real world purposes. We need to provide learning experiences that include literacy learning in ways that build on students' real life experiences and focus on the content students need to learn.

For example:

Why are plug holes round?

Teachers could provide each group of students with paper squares, rectangles, circles, and triangles. As a group, students could begin to list possible answers to this task. This type of question provides students with opportunities to share ideas, listen carefully to other students' suggestions, and to keep a record of possible explanations. If groups are having difficulty, encourage them to think about which shape they would choose if they want to put the plug in quickly. If this doesn't help, suggest considering axes of symmetry for each shape. Students can then move from oral texts to the joint construction of a written text.

Students should have opportunities to develop confidence in using spoken and written language in a variety of contexts. They should be encouraged to experiment with and explore ways of expressing ideas and communicating meaning as they develop their skills in writing for a number of purposes and audiences. They should be helped to develop as independent learners as they use language to make their meanings clear.

In working towards syllabus outcomes students will often be attempting language tasks which are new to them. These tasks need to be analysed in order to ascertain the specific demands that they will make on students. Once these demands are recognised and understood, students should be given appropriate support at points of need throughout the process to help them achieve success.

This support can take the form of **language scaffolds**. The following types of scaffolds could be used to provide assistance for students developing written texts. The first scaffold provides guidance to those students who may have difficulties writing up their findings. The second scaffold provides students with a broad structure and less detail.

Consider a task mentioned earlier:

Find five different-sized containers at home which each have a gross weight of 500 g. Describe these containers in terms of their shapes and measure the dimensions of the containers.

Scaffold 1:

The five different-sized containers that I found at home which each had a gross weight of 500 g were _______, _________, _________, _________, and ________.

The first container, which was the ________, was the shape of a _________[name of solid]. Its faces were made up of the following shapes: ________ and _________. When I measured the length, I found it was ___ cm long. Its width was ____ cm, and the height was ______ cm.

The second container, which was the ________, was the shape of a _________[name of solid]. Its faces were made up of the following shapes: ________ and _________. The length was ___ cm , its width was ____ cm and the height was ______ cm.

The third container was a ________. It was the shape of a _________[name of solid]. Its faces were made up of ________ and _________. The length was ___ cm, the width was ____ cm and the height was ______ cm.

The fourth container was the ________. It was the shape of a _________[name of solid] and its faces were made up of ________ and _________. The length of the _______ was ___ cm. Its width was ____ cm and the height was ______ cm.

The fifth container was the ________ and it was the shape of a _________[name of solid]. Its faces were made up of ________ and _________. The length of the ________ was ___ cm, its width was ____ cm and the height was ______ cm.

Scaffold 2:

State the problem

The problem is to find ____

____

____

What I did to solve the problem

I started this problem by ____

____

____

____

____

____

Describe each container (Don't forget to name the solid, the shape of the faces and the measurements). Diagrams may be used in your description.

____

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Learning environments need to be structured so that students are encouraged to take risks and are led to understand that approximating is a natural and necessary aspect of real learning. They need to feel that it is acceptable and appropriate to make approximations based on the level of knowledge and awareness a student currently has about literacy, while the teacher continues to provide exemplary models.

The mathematics learning activities in which students participate should be designed around real texts. Authentic texts, both spoken and written, form the context for teaching students about how language works and provide a contextual framework for achieving the syllabus outcomes.

For example:

A litre of petrol costs 68.9 cents. I buy 15 litres of petrol. How much is this?

A student attempting this question on a calculator will find that the answer 1033.5 appears on the screen. Many students will correctly divide by 100 and declare the cost to be $10.335. Although students can correctly use the calculator and understand part of the answer, support will need to be provided by the teacher when the interpretation of .335 is considered. This process helps to clarify the decimal conventions used in real texts relating to money.

Chapter 3: Assessing, planning and programming for explicit teaching

In order for teachers to plan appropriate programs they first need to ascertain what skills, knowledge and understandings their students currently have. This information needs to be considered in relation to the content which is to be taught and the literacy skills the students have which will give them access to the content.

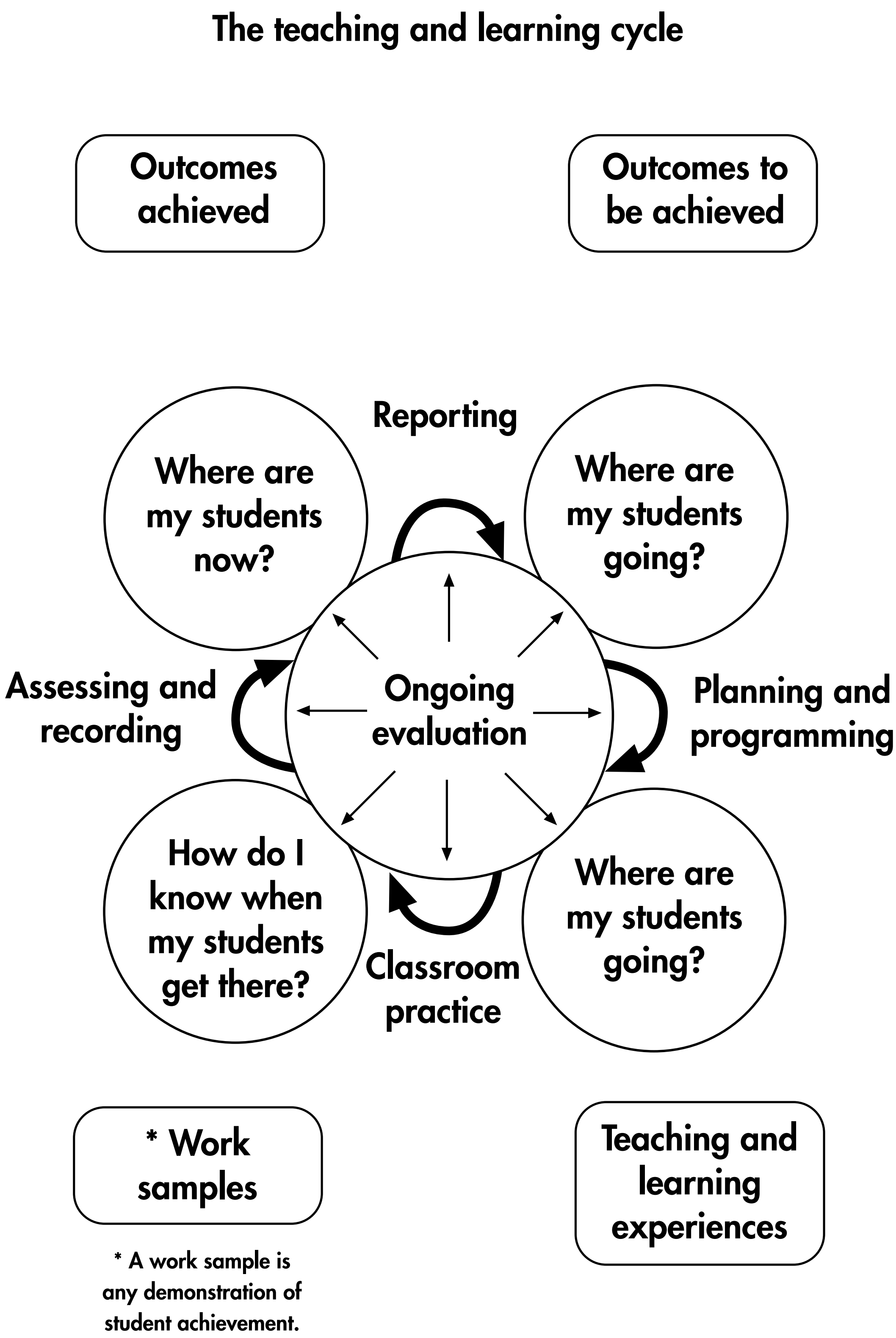
The Department of School Education publication, *Principles for assessment and reporting in NSW government schools* (1996), sets out some useful guidelines for assessing students' performance and should be read in conjunction with this chapter.

Collecting information about students' literacy achievements

Teachers of Year 7 should collect information about their students' literacy achievements from a range of sources.

1. Primary schools can provide a wealth of information about students' achievements and experiences in literacy and in the KLAs. Develop links with your local feeder primary schools so that you can begin to address such issues as what information would be most useful to you and the format in which it could be presented.
2. The English Language and Literacy Assessment (ELLA) results will provide information about students' skills in reading, language and writing, for both individual students and cohort groups. This will provide a snapshot of students' achievements which will give you a starting point for planning and programming appropriate learning experiences.
3. Any task in which students are involved is an assessment opportunity. Teachers are constantly making judgments about students' achievements and making decisions about further support, consolidation or acceleration on the basis of what students are demonstrating.
4. Support teachers within the school can provide additional information about students. ESL teachers can provide advice about students' levels of achievement using the ESL scales, and the implications of this for the teaching program. STLDs can provide advice about alternative or additional teaching strategies to assist those students who are experiencing difficulties.

The following diagram demonstrates the teaching and learning cycle.



What information needs to be collected?

1. Information needs to be collected about students' current knowledge, skills and understandings of the content area which the Years 7–8 mathematics syllabus outlines. Conducting quizzes and making "What we already know" charts will give information about appropriate starting points and will highlight students who require additional support and those who are ready for extension.
2. Information also needs to be collected about students' literacy skills, which will influence their ability to demonstrate proficiency in the new content. Consider what the literacy demands of the planned work will be. Determine whether students have encountered these sorts of demands before. It might be necessary to have students provide a piece of writing, or participate in an oral discussion, or you might have them read a piece of text to determine what level of support will be required. Think about the technical or subject-specific language which students will be required to use and the ways in which they will need to be supported. As Halliday (1991) points out, teachers have to diagnose when it is necessary to work on language itself, instead of just taking it for granted that their students are able to use language for learning. Examine the texts they will be required to read, to determine whether they will be too difficult or too simple for some students. It may be necessary to find a range of texts to suit the differing abilities of the students.

When students are assessed with pen-and-paper tests, teachers can mistakenly assume that a low-scoring child does not fully grasp the mathematical concepts which the test measures. The student's performance may be a result of a lack of lexical understanding. However, mathematics teachers often don't consider reading capability when assessing test performance. Mathematics language needs to be taught and learned well before it is met in assessment situations, and alternative strategies that do not rely upon reading, such as oral testing or less formal discussions, should be considered (Mousley and Marks, 1990). Students can be assisted to read more difficult texts by such strategies as:

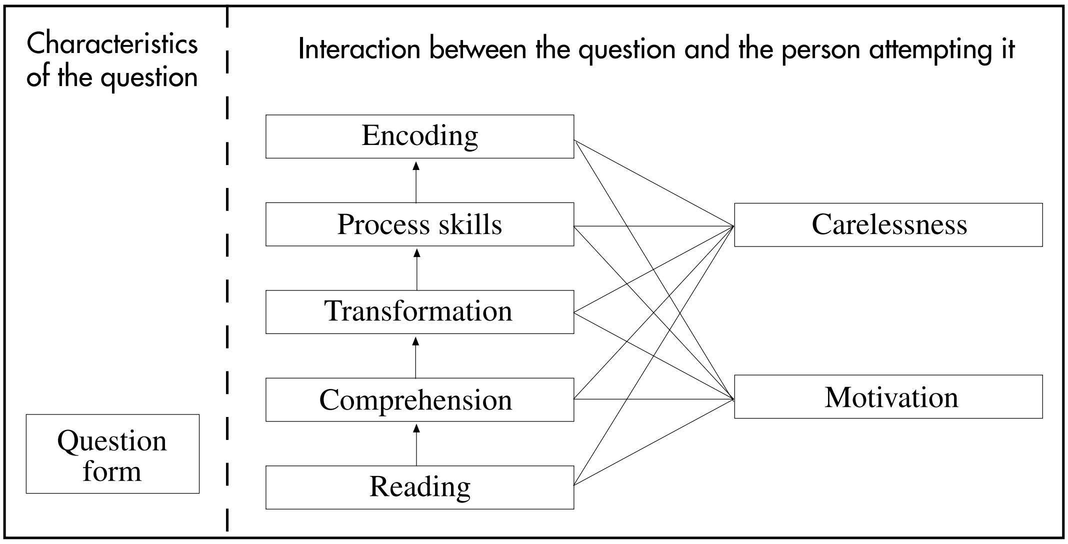
- highlighting new vocabulary and teaching it beforehand
- having students look at the headings and subheadings and predict what the text will be about
- considering the theme of a text and predicting what the contents might be.

Research conducted by Newman (1977) drew attention to the importance of mathematics vocabulary and semantics when understanding mathematical word problems. According to Newman, a student confronted with a written word problem needs to progress through five levels to obtain a correct solution.

These levels are examined by a series of questions she asked students as they attempted one-step word problems.

1. Please read the question to me. If you don't know a word leave it out.
2. Tell me what the question is asking you to do.
3. Tell me how you are going to find the answer.
4. Show me what to do to get the answer. Tell me what you are doing as you work.
5. Now write down the answer to the question.

Each of these requests corresponds to a level of the Newman hierarchy.



The Newman hierarchy of error causes (from Clements, 1980, p. 4)

When Newman interviewed low achievers in grade 6, she found that many of these children could not read the words in a problem, and many of those who could read the words could not comprehend the meaning of the problem. They did not know what it was they were being asked to do or find out. Newman found that about 40% of children's errors were due to misreading and lack of competency. These students either did not understand the words of the problem or, if they did understand, they had not devised appropriate strategies for solving the problem. Their failure was attributed to a reading deficiency, not a mathematics deficiency.

The same questions used in the Newman analysis can be used in a classroom to help students focus on where they are first making errors.

The following units of work will exemplify a range of strategies for using assessment to make decisions about the teaching program.

Unit one: Numbers

Syllabus reference

Year 7-8 syllabus, N1.1: Overview of the history of number and the development of the Hindu-Arabic number system.

Outcomes

This unit provides students with the opportunity to:

- recognise and state place value
- read, write, interpret and order numbers of any magnitude
- use inequality symbols to compare whole numbers.

Activity 1.1

30 mins

This activity will give students the opportunity to:

- read and order numbers, up to four digits.
- match numbers to words and match words to meanings
- order numbers and classify them according to the number of digits.

Resources

- Card Match (resource 1a), 1 set for each group.
- Card Match (resource 1b), 1 set for each group.
- Cloze passage (resource 2), one for each student.

Description

- In the first task, students work in small groups of three or four and match the numbers in words with the numerals (resource 1a).
- Teacher directs students to the second task of matching words with their meanings, using cards from resource 1b.
- After checking students' responses, teacher explains task 3, where students are required to order the numbers (resource 1a) in ascending or descending order (resource 1b).
- Teacher checks students' answers. The meaning of "digit" is clarified.
- Students classify the numbers as either two-, three- or four-digit numbers (resource 1b).
- Teacher checks students' answers.

- Students work in cooperative pairs to complete cloze passage (resource 2).

- It is important for the teacher not to assume that all students will have proficiency in reading, writing, spelling and saying numbers.

- Students need to associate spoken and written forms of numbers to help them with the writing, spelling and reading of numbers.

- Listen to discussions to determine if help is needed in pronunciation, reading or understanding of the numbers.

1. Thirty-five	d. 35
2. Fifty-three	b. 53
3. Three hundred and eight	i. 308
4. Three hundred and eighty	h. 380
5. Three thousand five hundred and eighty	j. 3580
6. Five hundred and three	a. 503
7. Three thousand five hundred and eight	g. 3508
8. Three thousand five hundred	e. 3500
9. Three thousand and five	c. 3005
10. Three thousand and fifty	f. 3050
	Numbers in words
	Numbers

- Students sort cards under these headings.

- Point out to students that commas and full stops are not used when writing whole numbers. These are used in some cultures.

- Note that the numbers used have the same digits. This ensures that students read carefully.

- Students should be made aware that spaces are not used in writing numbers with four digits or less.

- Groups could check other groups' answers.

- If some groups finish early they can use the cards to play "concentration". The cards are turned face down and the students take turns trying to match numbers with the words.

Activity 1.1 continued...

- Inform students that the words and the definitions to be matched are in boxes.
- Words are in double boxes and the meanings in single boxes.
- Give students other cues for remembering the terms *ascending* and *descending*. One possible cue is using the initial sounds of the words: ascending starts with the sound *a*, just like *attic*. Descending and down both start with *d*.

word	meaning
ascending	in order from smallest to largest
in order so that the numbers get bigger	going up
descending	in order from largest to smallest
in order so that the numbers get smaller	going down
two digits	three digits
four digits	

- Teachers often assume students understand common words such as *digit*. By classifying the numbers students are able to clarify the meaning.
- By providing a variety of definitions for *ascending* and *descending* the student is more likely to understand the meanings. Some students tend to 'parrot' definitions without any real understanding.

- The cloze passage is a good method of consolidating content covered in the card match. It can be used as another method of checking the students' understanding and improving reading skills while providing notes for their books.
- Leave enough words in the passage to enable students to predict missing words easily. Avoid making it a guessing game.
- Be aware that there may be more than one correct answer. Be flexible.
- When students are finished, the teacher could read the finished passage out aloud while students follow on their sheet. Discrepancies can be checked and students experiencing difficulties can practise matching the spoken and written word.

Ordering numbers

Numbers can be written in ascending or __________ order.

If numbers are written _____ ascending order that means that the smallest number is ________. The rest of the numbers get bigger and bigger. The largest number is always __________. The numbers 35, 53 and 103 are written in __________ order. If the numbers 820, 280, 802 and 208 are written in ascending order then this is the order in which they would be: ________, ________, ________, and ________.

When numbers are written in descending order then the largest __________ is always first. The rest of the numbers get ________ and smaller. These numbers are in descending order: 153, 150, 103, 53. If I write the numbers 418, 483, 438 and 348 in descending order, this would be the order in which they would be: ______, 438, ______, ______.

Word bank

208	descending	number	then
348	first	280	418
in	802	ascending	483
last	smaller		

- The cloze passage may be done in class individually, in pairs or as homework. It may also be the students' notes.

- When students finish, have them read the passage to a neighbour. Apart from practising terminology, this technique ensures that what the student has written makes sense.
- Some students need more clues than others when completing the passage. Adding the first letter of the missing word helps. Broken lines can be used to indicate the number of letters in the word.
- If students are having trouble, have them read the surrounding text for clues. Ask them to read on and read back.
- Word banks are optional. They may have the required words only or they may include extra words. Students can be restricted to using words only from the word bank or they may use the word bank, only if they need to.

Activity 1.2

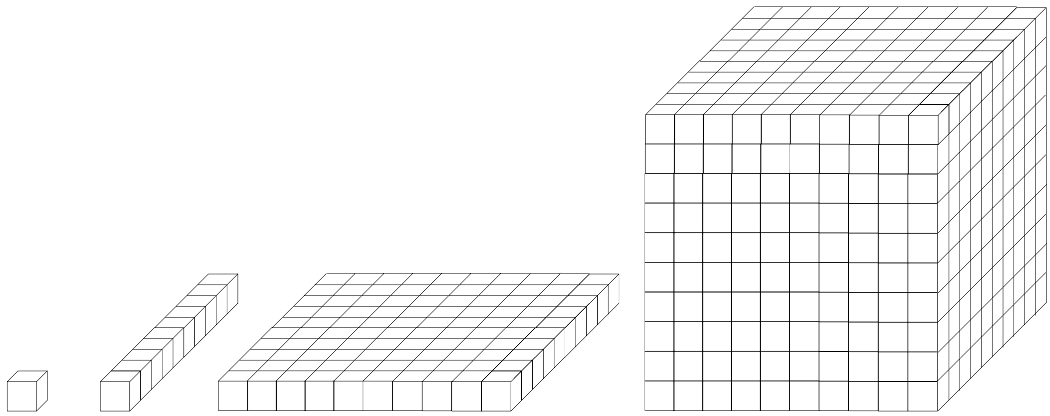
In this activity students use Dienes blocks to demonstrate understanding of place value. They “build” and read numbers while becoming more familiar with terminology: bigger, smaller, less than, greater than, closest in value to, digits ...

Resources

- Dienes blocks (base 10 material), enough for each group if possible.
- Place value chart (resource 3), one for each group.
- Question cards (resource 4a and 4b), one set of each for teachers’ use.

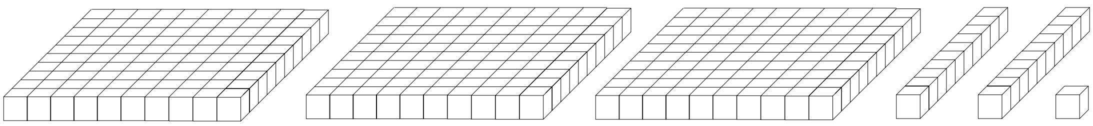
Description

- Organise students in groups of 4-6.
- Introduce the Dienes blocks, making students aware of how many units each block is equal to.



cube = 1   **long = 10**   **flat = 100**   **big block =1000**

- Model building numbers using the Dienes blocks and place value chart (resource 3). For example the number 321 would be represented by



- Tell students the numbers to be constructed using the blocks (resource 4a).
- Check students’ answers by questioning.
- Use cards (resource 4b) as tasks.
- Students build a suitable number in response.
- Select some students to read their answers out aloud.
- Choose next card (resource 4b) and repeat the process.

Activity 1.2 continued...

- Headings written in words and index notation enable the chart to be used for expanded notation. It could also be used for addition, subtraction and multiplication using concrete materials.

- The chart needs to be at least A3 size and could be laminated.

Thousands $10^3 = 1000$	Hundreds $10^2 = 100$	Tens $10^1 = 10$	Units $10^0 = 1$

- Students practise their listening skills as they "build" numbers in response to a verbal rather than written request.

- Ask questions about students' responses, for example:
  - Who has the largest three digit number: who has the smallest?
  - Whose number is closest in value to 3000?
  - Whose number is larger than 800?

Make a number that is less than 35	Make a number which has three digits and is bigger than 126
Make a four digit number	Make the largest three digit number that you can
Make a number that is bigger than one hundred and eighty-nine	Make the smallest three digit number that you can
Make a 2 digit number which is smaller than thirty-two	Make a three digit number that is bigger than one hundred and thirty-five but is less than 153

- In groups, students could write questions similar to the ones asked by the teacher. They could have turns reading their question to the other groups, who would "build" the answer.

- If students say their answer it gives them the opportunity to practise pronunciation. ESL students in particular need this practice.

Activity 1.3

25 mins

Students use arrow cards to make numbers up to four digits. Using these cards reinforces their knowledge of place value and establishes early understanding of expanded notation.

Resources

- Cards (resource 4b), one set for each group.
- Arrow cards (resource 5), one set for each group.
- Worksheet (resource 6), one for each student.

Description

- Students work in groups of two or three.
- Teacher demonstrates how the arrow cards can be used to make numbers. The cards are placed on top of each other, from largest to smallest, with the arrow heads lined up.
- Students use question cards (resource 4b) and make the answers using arrow cards (resource 5). The question and number cards can be placed side-by-side for checking, either by the teacher or another group.
- Students work together to complete the worksheet (resource 6).

- Students are given the opportunity to discuss numbers with each other. Terminology and vocabulary are practised and reinforced throughout the activity.

- Question cards have numbers written using numerals and words. This reinforces the reading and writing of numbers.

Make a number that is less than 35	Make a number which has three digits and is bigger than 126
Make a four digit number	Make the largest three digit number that you can
Make a number that is bigger than one hundred and eighty-nine	Make the smallest three digit number that you can
Make a 2 digit number which is smaller than thirty-two	Make a three digit number that is bigger than one hundred and thirty-five but is less than 153

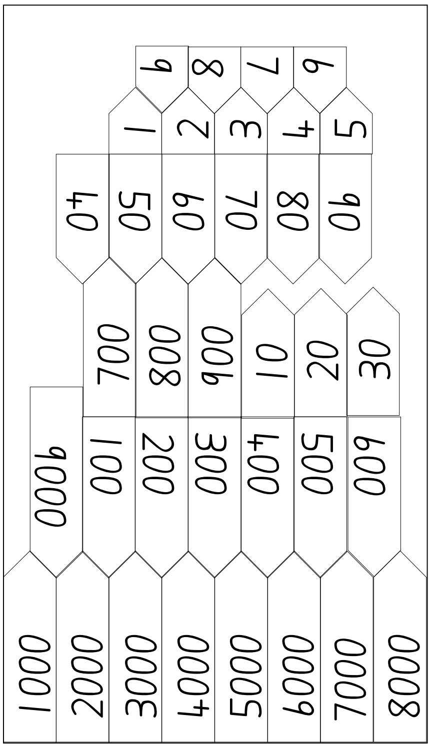
- The teacher can build a number and ask the students to provide a description of the number, e.g. teacher builds 374, students could write: "This is a 3 digit number which is less than 400…"

- Students could play a game of "celebrity heads". Three selected students wear a number on their head and try to guess what number they are by asking the rest of the class questions which can be answered only with a yes or no. If they get a yes answer then they are able to ask another question. The first student to guess the number is the winner.

Activity 1.3 continued...

- This activity can lead directly into expanded notation (Syllabus reference N1.2).

- The arrow cards can be copied onto an OHT and cut up for teacher demonstration.



- Let students cut the arrows out. Place each set in ‘snap lock’ lunch bags for storage.

- The worksheet can be completed in class or as homework.

- Leaving one space for each word encourages students to use joining words such as *and*.

- Emphasise that when writing numbers in words only the singular form is used, e.g. *four thousand* not *four thousands* etc.

Complete the following:

Number using expanded form	Number	Number in words
400 > 20 > 5 >	______	______ ______ ______ ______ ______
______ > ______ > ______ >	______	Three thousand two hundred and four
______ > ______ > ______ >	673	______ ______ ______ ______ ______
1000 > 200 > 50 > 3 >	______	______ ______ ______ ______ ______ ______ ______
9000 > 9 >	______	______ ______ ______ ______

Complete the following by putting a word in each space.

Four hundred ______ eight is a three digit number which has ______ hundreds and eight units. It is ______ than four hundred and eighteen.

A number which is larger than three ______, two hundred and twelve is three thousand, two hundred and thirty. Both of these numbers have four ______ .

______ hundred and sixteen is a three digit number which has five hundreds, one ______ and six units. It is ______ than five hundred and twenty.

- The sentences are missing a variety of words – numbers, joining words, specialised vocabulary.

- Students need to read the surrounding text to be able to complete the sentences.

- By successfully completing the passage, students demonstrate their level of understanding.

- Students can compare answers with other pairs of students.

Activity 1.4

20 mins

Students complete a card matching task to support the learning of terminology and mathematical symbols. They then use the symbols to complete a worksheet.

Resources

- Cards (resource 7).
- Workcard (resource 8).

Description

- Students work in small groups of two or three and match symbols to words (resource 7).
- Following this, students use each of the symbols once to complete the worksheet (resource 8) so that all statements are true. There may be more than one correct solution.

<	1. is less than
>	2. is greater than
⩽	3. is less than or equal to
⩾	4. is greater than or equal to
≮	5. is not less than
≯	6. is not greater than
=	7. is equal to, equals
≠	8. is not equal to
≑ or ≈	9. is approximately equal to

- Give students help for remembering < and >. You could point out that the words *less than* start with the letter *L* which looks similar to <, or that the open end is closest to the largest number.

- Point out that a line through a symbol means *is not*.

- Ensure that the students know the meaning of *approximately*.

- Use the symbols (from resource 7) only once. They must all be used once. Be aware that there may be more than one correct solution.

Use each symbol once (<, ⩽, ≮, >, ⩾, ≯, =, ≠, ≑ to make the following true.

2137		2160
4271		4270
2035		2053
1132		1103
2185		2158
1312		1312
1142		1124
1220		1200
2153		2153

Activity 1.5

20 mins

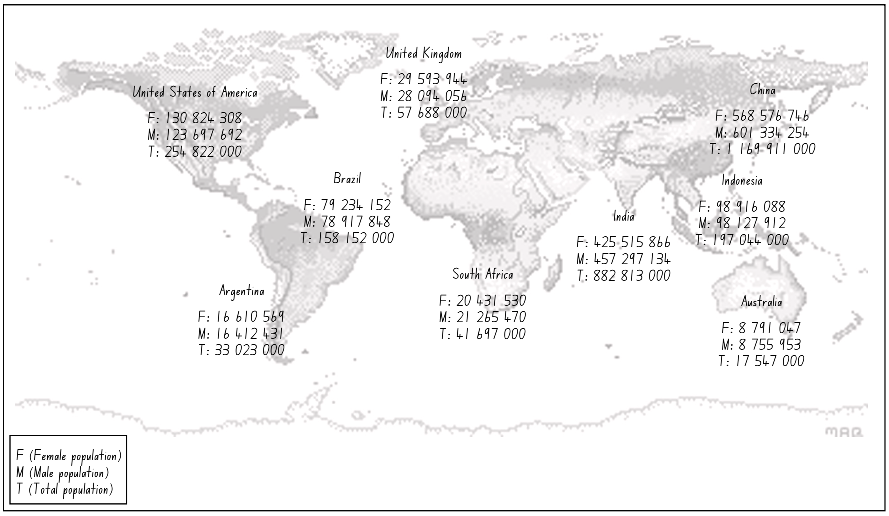
In this activity students use world populations to order and compare large numbers.

Resources

- Puzzle of world (resource 9).
- Worksheet (resource 10).

Description

- Group students in pairs and explain the puzzle and worksheet.
- Students complete puzzle (resource 9) and use it to answer the worksheet (resource 10).



World populations

Use the puzzle of the world which shows some countries and their populations to help you answer these questions.

1 Write in words:

a) Australia's female population

b) China's male population

2. Complete the following tables

a) Put the female populations in ascending order

Population	Country

b) Put the male populations in descending order

Population	Country

3a) Which country has the smallest female population?

b) Which country has the largest male population?

4. Indicate whether the following statements are true or false.

a) Australia's total population is less than Brazil's total population.
b) The female population of Indonesia is greater than its male population.
c) China's population is larger than India's population.
d) The population of the United Kingdom is greater than the population of Indonesia.
e) Of the countries shown, Australia has the smallest population.

- This is a way of incorporating a real life application with the use of large numbers.
- The activity emphasises that mathematics is used in other KLAs.
- This activity could also be used for addition and subtraction of large numbers, approximation of numbers, percentages, ratio etc.

Activity 1.6

45 mins

In this activity the students reconstruct a passage on early number systems. They will then complete a squaresaw using these systems.

Resources

- Text cards (resource 11).
- Squaresaw (resource 12).

Description

- Group students in pairs and explain the activity.
- Students work cooperatively to reconstruct text (resource 11).
- Students complete squaresaw (resource 12), using information from the reconstructed passage.

History of number

The history of number begins with early humans, who did not have a complex number system.

Complex number systems developed as the need for large numbers grew.

One of the earliest systems was invented by the Egyptians, who used a tally system based on ten.

Ten of one symbol could be changed for another symbol.

In this number system the order of symbols did not matter.

Here are some of the symbols the Egyptians used.

Table 1:

1	|	a vertical staff
10	∩	a heel bone
100		a coiled rope
1000		a lotus flower
10 000		a bent reed or pointed finger
100 000		a burbot fish or tadpole
1 000 000		an amazed man or god of infinity
10 000 000		a religious symbol

Another system was the Roman number system.

It is still used today on some watches and clocks.

Roman numbers are also used at the end of movies to tell you when the movie was made.

In the Roman system, if a smaller unit appears before a larger one, it is subtracted from the larger one, for example V = 5, I = 1 so IV = 4.

Here are some of the symbols the Romans used.

Table 2:

1	I	one finger
5	V	one hand
10	X	two Vs
50	L	half a C
100	C	centum = hundred
500	D	half an
1 000	M	

A third system is the Hindu-Arabic system.

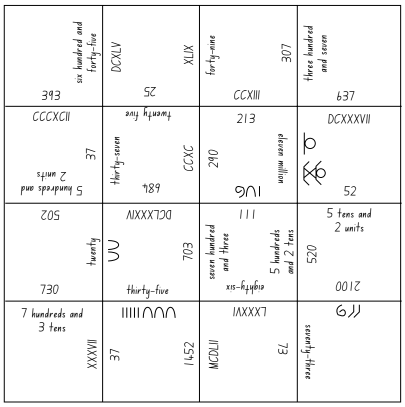
It was invented by the Hindus around 300BC.

In this number system the position of a symbol (number) is very important and a zero is used instead of using an empty space.

Hindu-Arabic symbols are the symbols we use in Australia today.

- The passage must be reconstructed so that it makes sense grammatically.
- Use students' text books as a resource for passages.
- When writing passages for reconstruction make sure that sentences link. The order of the sentence should be obvious to someone with good knowledge of the subject.
- Students must draw on their knowledge of a topic and use clues provided by the grammatical structure of the text.
- A method of checking could be that students be asked to read aloud a sentence each, and the class could decide whether or not it follows logically from the previous sentence.
- Text reconstructions and squaresaws are best done in pairs.

"Squaresaw": The history of number



Instructions for use:

1. The "squaresaw" is cut so that each set consists of 16 cards. Get students to cut them up before they are used the first time.
2. Students work in pairs to put the "squaresaw" back together so that symbols and words match.

- Reconstructed text should be followed with an activity which makes use of information from the passage.
- Students enjoy doing squaresaws and they are an easy resource to prepare.
- Squaresaws can be used in many topics, such as measurement, algebra.
- Make sure that you use different orientations.
- Note that the squaresaw covers earlier work as well (numbers in words…).
- Students need to work cooperatively in order to complete the task.

Resource 1a

1.	Thirty-five
2.	Fifty-three
3.	Three hundred and eight
4.	Three hundred and eighty
5.	Three thousand five hundred and eighty
6.	Five hundred and three
7.	Three thousand five hundred and eight
8.	Three thousand five hundred
9.	Three thousand and five
10.	Three thousand and fifty

d.	35
b.	53
i.	308
h.	380
j.	3580
a.	503
g.	3508
e.	3500
c.	3005
f.	3050
	Numbers in words
	Numbers

Resource 1b

word	meaning
ascending	in order from smallest to largest
in order so that the numbers get bigger	going up
descending	in order from largest to smallest
in order so that the numbers get smaller	going down
two digits	three digits
four digits	

Resource 2

Ordering numbers

Numbers can be written in ascending or __________ order.

If numbers are written _____ ascending order that means that the smallest number is _________. The rest of the numbers get bigger and bigger. The largest number is always __________. The numbers 35, 53 and 103 are written in ____________ order. If the numbers 820, 280, 802 and 208 are written in ascending order then this is the order in which they would be: ________, ________, _________, and _________.

When numbers are written in descending order then the largest __________ is always first. The rest of the numbers get _________ and smaller. These numbers are in descending order: 153, 150, 103, 53. If I write the numbers 418, 483, 438 and 348 in descending order, this would be the order in which they would be: ______, 438, _______, ________.

Word bank

208	descending	number	then
348	first	280	418
in	802	ascending	483
last	smaller		

Resource 3

Thousands	Hundreds	Tens	Units
$10^3 = 1000$	$10^2 = 100$	$10^1 = 10$	$10^0 = 1$

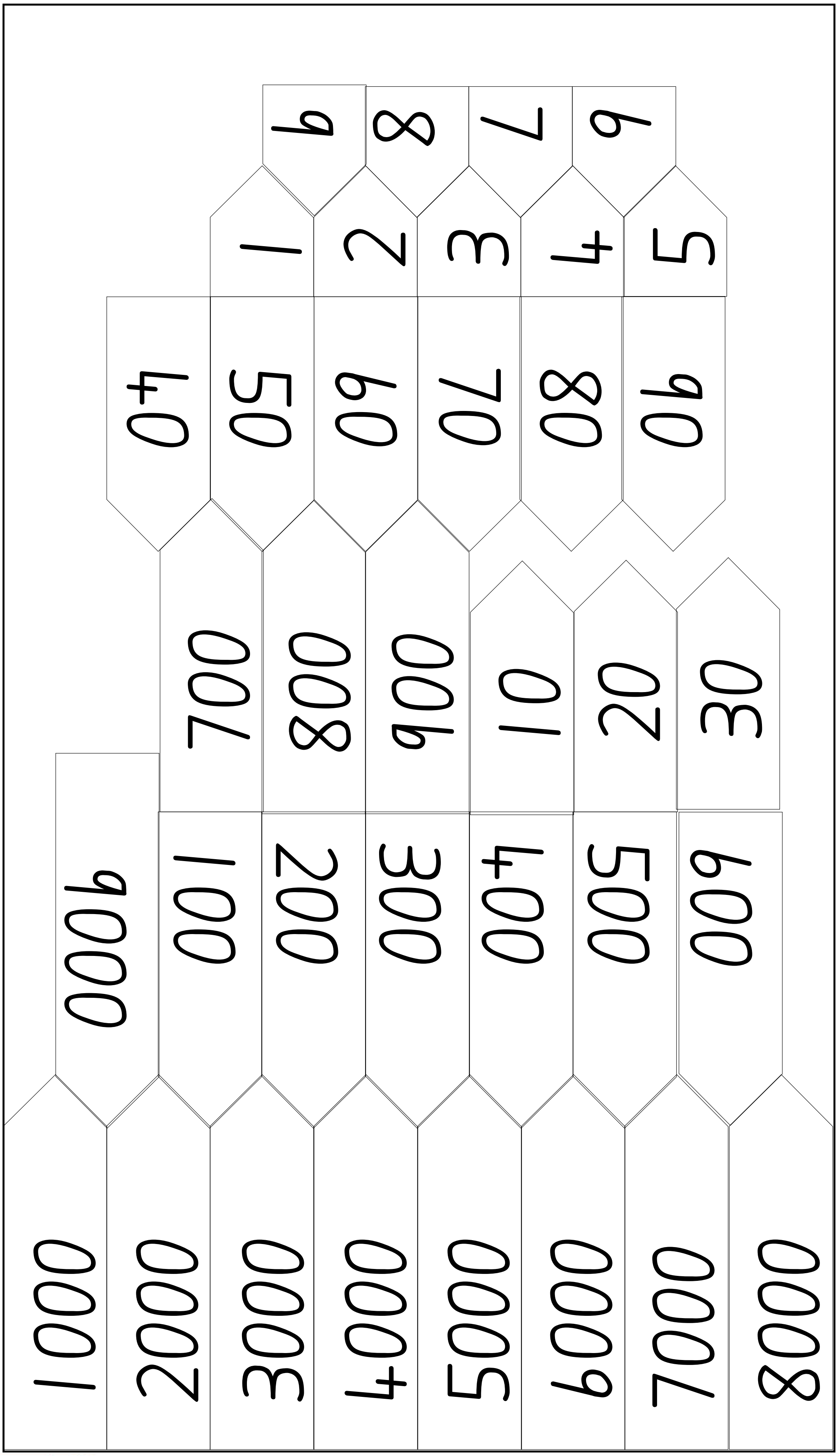
Resource 4a

215	36
1030	403
1101	205
430	250
2107	1270

Resource 4b

Make a number that is less than 35	Make a number which has three digits and is bigger than 126
Make a four digit number	Make the largest three digit number that you can
Make a number that is bigger than one hundred and eighty-nine	Make the smallest three digit number that you can
Make a 2 digit number which is smaller than thirty-two	Make a three digit number that is bigger than one hundred and thirty-five but is less than 153

Resource 5


1000
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60
70
80
90
1
2
3
4
5
6
7
8
9

Resource 6

Complete the following:

Number using expanded form	Number	Number in words
400 20 5	______	______ ______ ______ ______ ______
______ ______ ______	______	Three thousand two hundred and four
______ ______ ______	673	______ ______ ______ ______ ______
1000 200 50 3	______	______ ______ ______ ______ ______ ______ ______
9000 9	______	______ ______ ______ ______

Complete the following by putting a word in each space.

Four hundred ______ eight is a three digit number which has ______ hundreds and eight units. It is ______ than four hundred and eighteen.

A number which is larger than three ______, two hundred and twelve is three thousand, two hundred and thirty. Both of these numbers have four ______.

______ hundred and sixteen is a three digit number which has five hundreds, one ______ and six units. It is ______ than five hundred and twenty.

NEALS

Resource 7

$<$	1. is less than
$>$	2. is greater than
$\leqslant$	3. is less than or equal to
$\geqslant$	4. is greater than or equal to
$\nless$	5. is not less than
$\ngtr$	6. is not greater than
$=$	7. is equal to, equals
$\neq$	8. is not equal to
$\doteqdot$ or $\approx$	9. is approximately equal to

Resource 8

Use each symbol once (<, ≤, ≮, >, ≥, ≯, =, ≠, ≑ to make the following true.

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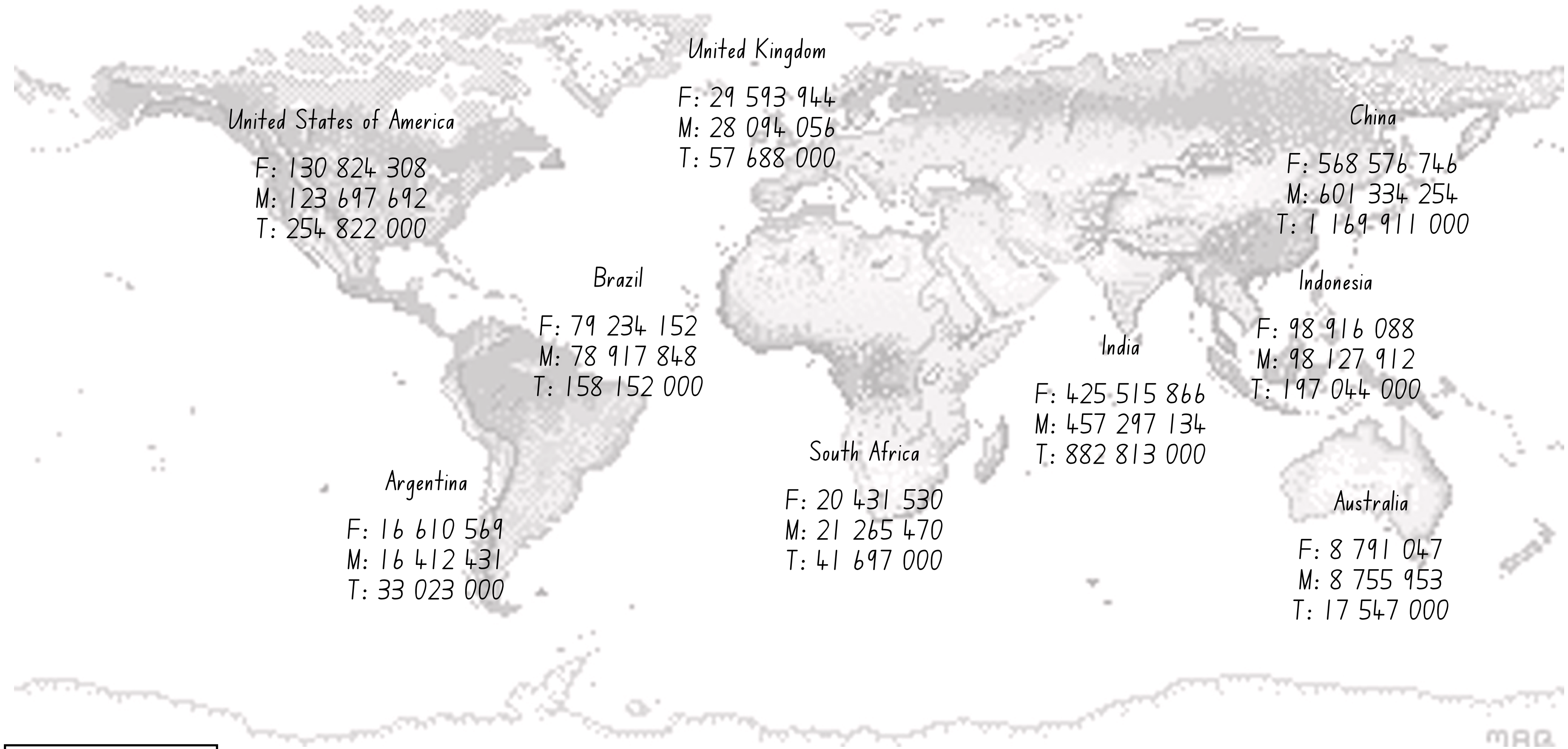
Resource 9



F (Female population)
M (Male population)
T (Total population)

Resource 10

World populations

Use the puzzle of the world which shows some countries and their populations to help you answer these questions.

1. Write in words:

a) Australia's female population

____

b) China's male population

____

2. Complete the following tables

a) Put the female populations in ascending order

Population	Country

b) Put the male populations in descending order

Population	Country

3a) Which country has the smallest female population?

____

b) Which country has the largest male population?

____

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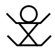
10 000		a bent reed or pointed finger
100 000		a burbot fish or tadpole
1 000 000		an amazed man or god of infinity
10 000 000		a religious symbol

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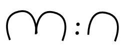
In the Roman system, if a smaller unit appears before a larger one, it is subtracted from the larger one, for example V = 5, I = 1 so IV = 4.

Here are some of the symbols the Romans used.

Table 2:

1	I	one finger
5	V	one hand
10	X	two Vs 
50	L	half a C 
100	C	centum = hundred
500	D	half an 
1 000	M	

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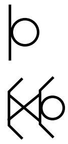
Hindu-Arabic symbols are the symbols we use in Australia today.

Resource 12

"Squaresaw": The history of number

six hundred and forty-five; 393	DCXLV; XLIX; 25	forty-nine; 307; CCXIII	three hundred and seven; 637
CCCXCII; 37; 5 hundreds and 2 units	twenty five; thirty-seven; CCXC; 684	213; 290; eleven million; 9∩I	DCXXXVII; ; 52
502; twenty; 730	DCLXXXIV; ∪∪; 703; thirty-five	III; seven hundred and three; 5 hundreds and 2 tens; eighty-six	5 tens and 2 units; 520; 2100
7 hundreds and 3 tens; XXXVII	IIIII∩∩∩; 37; 1452	LXXXVI; MCDLII; 73	6)); seventy-three

Instructions for use:

1. The "squaresaw" is cut so that each set consists of 16 cards. Get students to cut them up before they are used the first time.

2. Students work in pairs to put the "squaresaw" back together so that symbols and words match.

Unit two: Fractions

Syllabus reference

Year 7-8 syllabus, N5.1: Concept and representation of fractions as part of a whole.

Outcomes

This unit provides students with the opportunity to:

- recognise fractions shaded
- find $\frac{1}{2}$, $\frac{1}{3}$ of a quantity
- recognise fractional parts as not being equal.

Activity 2.1

15 mins

This activity will give students the opportunity to clarify their understanding of basic fractions. They will match symbols, words and definitions to diagrams representing fractions.

Resources

- Cards made from Resource 13 (one set for each group).

Description

- In small groups of 3 or 4, students find the double boxed cards and place them in a row across the table in the order: diagram, shaded fraction, shaded fraction in words, and meaning.
- Students find the numbered diagram cards and put them in numerical order. Marking is easier when all groups have their cards in the same order.
- Students match remaining cards under the headings.
- Teacher monitors groups, asking one student out of each group questions such as: “Can you explain why this diagram shows three-sevenths shaded?”, “The fraction is made up of how many equal parts?”
- After five minutes, have groups “send out a spy”. One student leaves his or her group and looks at other groups’ work. The purpose is to confirm that groups are on the right track.
- Teacher checks groups’ work. There are numerous methods for checking:

1. Check the first group finished. If correct, send each student to another group to check that group’s solutions.
2. Use an overhead of the resource page.
3. Check every group. Good luck!

Activity 2.1 continued...

- Check that students understand the term “shaded”.

- Teachers should not assume that students can say fractions using mathematical vocabulary, e.g. $\frac{1}{2}$ is said “one half” not “one over two”.

- Jointly listen to group discussions and assist with pronunciation, reading or understanding of the concept of a fraction.

- Emphasise the words “equal parts” and the concept.

- Students should clear their desks before commencing the activity so that every group member has a clear vision of the cards.

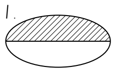
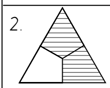
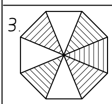
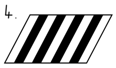
- Cards should be orientated so that no student is reading upside down.

- Students should be encouraged to participate – actively move their chairs if necessary.

- Listen to the “maths chat” generated – it’s amazing!

- Encourage pronunciation of the “th” in fifths, sixths… Practise spelling.

- Have students sort cards under these headings.

Diagram	Shaded fraction	Shaded fraction in words	Meaning
1. 	$\frac{1}{2}$	one-half	The shape is divided into two equal parts. One equal part is shaded.
2. 	$\frac{2}{3}$	two-thirds	The shape is divided into three equal parts. Two equal parts are shaded.
3. 	$\frac{3}{7}$	three-sevenths	The shape is divided into seven equal parts. Three equal parts are shaded.
4. 	$\frac{5}{8}$	five-eighths	The shape is divided into eight equal parts. Five equal parts are shaded.

- Note the diagram cards have used many different 2D shapes reinforcing vocabulary from a previous topic.

- Diagram cards are numbered so all groups have their cards in the same order. This makes it easier for checking.

- Raise students’ awareness of the difference in language and concept, between ordinal numbers (first,second, third… no *s* on the end) and the bottom number in a fraction (halves, thirds, quarters… *s* on the end).

- A useful follow-up is an exercise where students, working individually, repeat the matching process on a worksheet. This becomes a record of the activity for future reference. (ESL and other students often refer to their worksheets as a mathematics dictionary.)

Activity 2.2

This is a short activity which requires students to recognise fractional parts as being equal. Students classify cards, which show different applications of fractions, as either true or false.

Resources

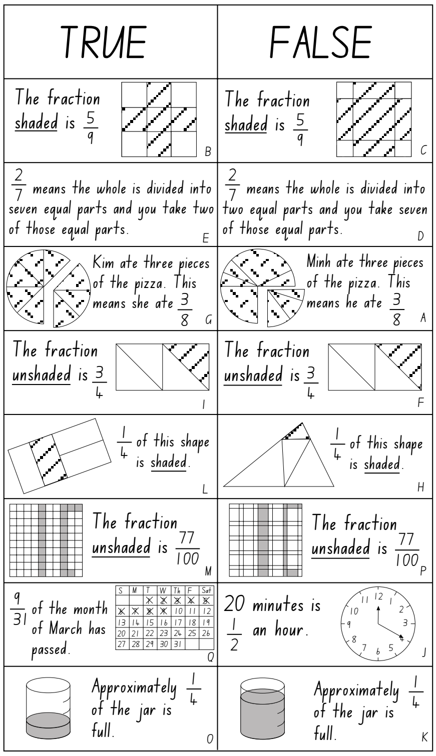
- Cards made from resource 14 (one set per pair).

Description

- Students work in pairs to classify each fraction card as either true or false.
- As pairs complete the activity, form groups of four to discuss and compare their results.
- Teacher checks solutions, encouraging discussion about disagreements and continually emphasising equal parts.

- Always specify a time limit for these types of activities.

- Listen to pair discussions. Assist with reading of the cards, correct pronunciation and clarification of concepts.



- Raise students' awareness of underlined words.

Activity 2.3

This activity consolidates finding halves, thirds, quarters, sixths, eighths and twelfths of a quantity in a game situation.

Resources

- "Shade the fraction" gameboard: resource 15 (one per two students for one game).
- Two cubes labelled as in resource 15 (per four students).

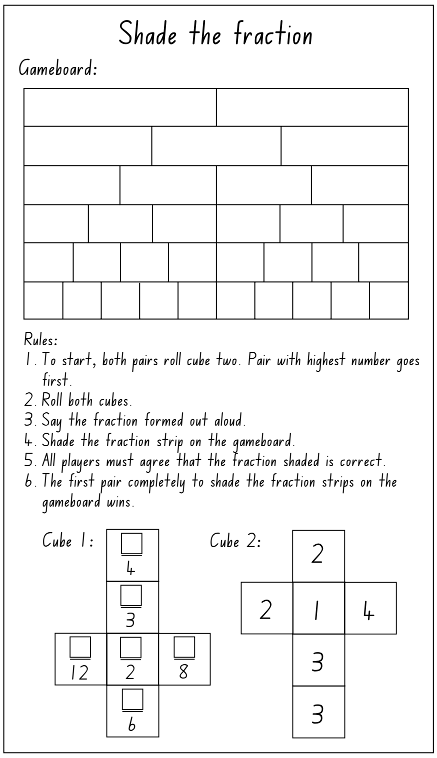
Description

- Group students in pairs and place two pairs together, one pair against the other.
- Distribute equipment and ask students to read the rules silently.
- Ask each pair to discuss the rules with each other.
- Clarify rules with the whole class by asking different groups to explain.
- Students play the game.

- Cube 2 shows the numerator to be placed in the box on cube 1.

- The activity clarifies the meaning of the top and bottom number in a fraction.

- Initial silent reading of the rules allows students to get a general idea of the game.


Shade the fraction

Gameboard:

Rules:
1. To start, both pairs roll cube two. Pair with highest number goes first.
2. Roll both cubes.
3. Say the fraction formed out aloud.
4. Shade the fraction strip on the gameboard.
5. All players must agree that the fraction shaded is correct.
6. The first pair completely to shade the fraction strips on the gameboard wins.

- When students verbalise their understanding of the rules, misunderstandings can be clarified.

- Encourage students to say the fraction they are shading, e.g. "I am shading two of three equal parts, which is two-thirds".

- This activity is also useful for equivalent fractions.

Activity 2.4

50 mins

This activity gives the students the opportunity to investigate problems involving fractions shaded, and equal fractional parts. It also models a structure to assist students in writing detailed explanations of how they solved the problem.

Resources

- Resource 16 and 17 (one per student, not back-to-back).
- Resource 17 (OHT for teacher).
- Resource 18 (one per student).
- Resource 19 (one per student).
- Butcher's paper or scrap paper, and coloured textas.

Description

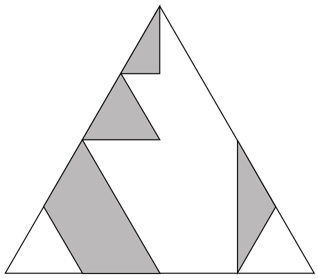
- Students form groups of 3 or 4.
- Distribute resource 16 to every student and explain the activity. At this stage, groups discuss strategies for solving the problem (finding the fraction shaded). Each group then shares with the class one strategy used.
- Groups are given five minutes to solve the problem.
- Distribute resource 17 to each student and ask groups to read the example, underlining any words that are unfamiliar.
- Students, in groups, discuss underlined words. Then you could clarify any unexplained meanings with the class.
- Model writing another explanation, using resource 17 as the overhead, focusing on one group's strategies.
- Working in the same groups, students investigate the next problem (resource 18). Encourage groups to write the first draft of their explanation on butcher's paper and edit their work.
- Monitor groups' progress.
- Edited first draft is checked by teacher.
- Students individually write their group's edited explanation on their worksheet (resource 17).
- Resource 19 could be used as an extension problem for fast working groups, as an assessment task, or as an individual task for homework.

Activity 2.4 continued...

- When drawing students' attention to the "hint" diagram, emphasise equal parts.

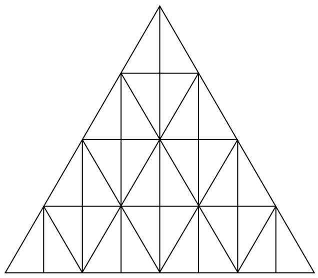
- Remind students about all the different problem-solving strategies that are available to them, e.g. guess and check, drawing, colouring, moving, cutting and superimposing, considering a smaller problem.

What fraction of the diagram is shaded?



Write up to half a page describing how you were able to answer this question.

Hint: This diagram may be helpful.



- Underline key words in the problem.

- Technical vocabulary, such as *equilateral triangle, calculate*, may be difficult for students. Write them on the board or overhead transparency as required.

- Ordering sentences for the explanation could be a problem for some students. Each idea could be numbered then put in preferred order after editing. Alternatively, each idea could be written on separate strips of paper and physically moved until students are happy with the order. Editing can then be completed.

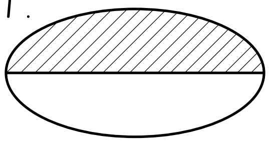
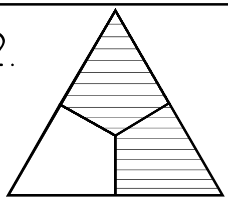
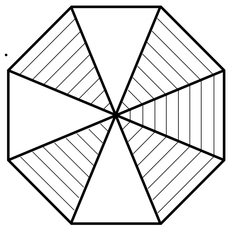
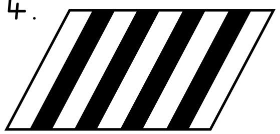
- When grouping, make sure that students with weak language skills are spread across groups.

- Use of the prepositions, *in, of, with, to, from*, is another difficult aspect of using English for mathematical purposes. Have students regularly read their explanation out loud to other group members, checking that it makes sense.

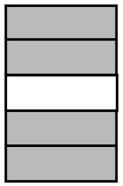
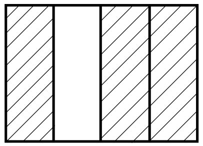
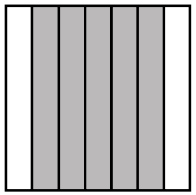
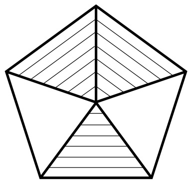
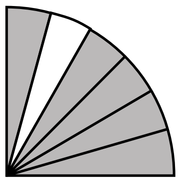
Explanation			
Structure		Example	
Introduce topic or problem to be explained.		Introduce topic or problem to be explained.	The problem is to explain how to find the fraction of the diagram that is shaded.
Series of explanations. (Could involve diagrams, illustrations, mathematics, explaining how to solve the problem)		Series of explanations. (Could involve diagrams, illustrations, mathematics, explaining how to solve the problem)	We started by looking at the hint diagram the teacher provided. The 8cm equilateral triangle was divided into 32 small right-angled triangles of equal size. Tom measured the triangle in the shaded diagram and discovered it was also an 8cm equilateral triangle. Together we discussed how we could calculate the fraction of the diagram that is shaded. Trinh said we should cut out one of the small triangles from the hint diagram and put it in the shaded diagram. The group "greed that this was a good solution until Jelena said "Why don't we just colour the hint diagram to match then shaded diagram?" Then we counted the small triangles we coloured.
Conclusion (answer to the problem)	We found the fraction shaded to be...	Conclusion (answer to the problem)	We found the fraction shaded to be $\frac{11}{32}$.

- Knowledge and language skills develop together.

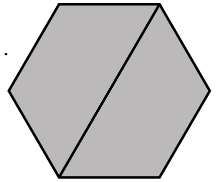
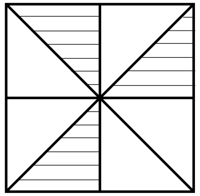
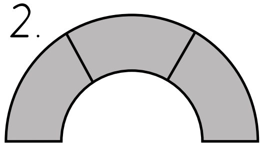
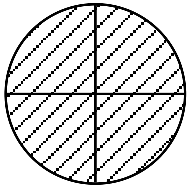
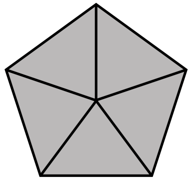
Resource 13a

Diagram	Shaded fraction	Shaded fraction in words	Meaning
1. 	$\frac{1}{2}$	one-half	The shape is divided into two equal parts. One equal part is shaded.
2. 	$\frac{2}{3}$	two-thirds	The shape is divided into three equal parts. Two equal parts are shaded.
3. 	$\frac{3}{7}$	three-sevenths	The shape is divided into seven equal parts. Three equal parts are shaded.
4. 	$\frac{5}{8}$	five-eighths	The shape is divided into eight equal parts. Five equal parts are shaded.

Resource 13b

5. 	$\frac{4}{5}$	four-fifths	The shape is divided into five equal parts. Four equal parts are shaded.
6. 	$\frac{3}{4}$	three-auarters	The shape is divided into four equal parts. Three equal parts are shaded.
7. 	$\frac{5}{7}$	five-sevenths	The shape is divided into seven equal parts. Five equal parts are shaded.
8. 	$\frac{3}{5}$	three-fifths	The shape is divided into five equal parts. Three equal parts are shaded.
9. 	$\frac{5}{6}$	five-sixths	The shape is divided into six equal parts. Five equal parts are shaded.

Resource 13c

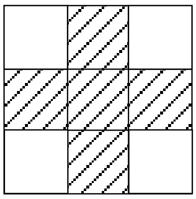
10. 	$\frac{2}{2}$	two-halves (one whole)	The shape is divided into two equal parts. Both equal parts are shaded.
11. 	$\frac{3}{8}$	three-eighths	The shape is divided into eight equal parts. Three equal parts are shaded.
12. 	$\frac{3}{3}$	three-thirds (one whole)	The shape is divided into three equal parts. Three equal parts are shaded.
13. 	$\frac{4}{4}$	four-quarters (one whole)	The shape is divided into four equal parts. Four equal parts are shaded.
14. 	$\frac{5}{5}$	five-fifths (one whole)	The shape is divided into five equal parts. Five equal parts are shaded.

Resource 14

TRUE	FALSE

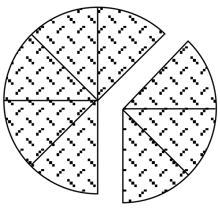
TRUE

The fraction shaded is $\frac{5}{9}$



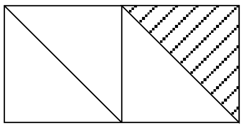
B

$\frac{2}{7}$ means the whole is divided into seven equal parts and you take two of those equal parts. E

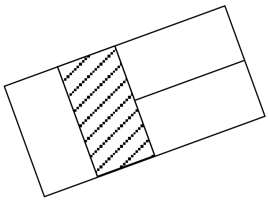


Kim ate three pieces of the pizza. This means she ate $\frac{3}{8}$ G

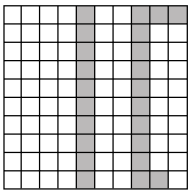
The fraction unshaded is $\frac{3}{4}$



I



$\frac{1}{4}$ of this shape is shaded. L

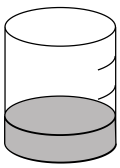


The fraction unshaded is $\frac{77}{100}$ M

$\frac{9}{31}$ of the month of March has passed.

S	M	T	W	Th	F	Sat
		~~1~~	~~2~~	~~3~~	~~4~~	~~5~~
~~6~~	~~7~~	~~8~~	~~9~~	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

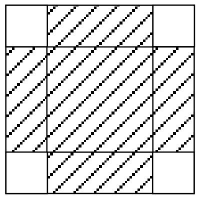
Q



Approximately $\frac{1}{4}$ of the jar is full. O

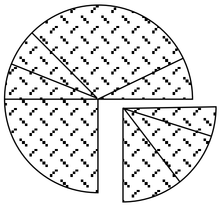
FALSE

The fraction shaded is $\frac{5}{9}$



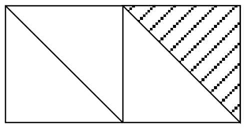
C

$\frac{2}{7}$ means the whole is divided into two equal parts and you take seven of those equal parts. D

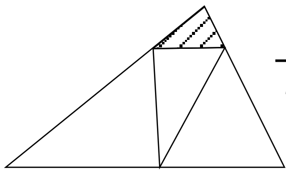


Minh ate three pieces of the pizza. This means he ate $\frac{3}{8}$ A

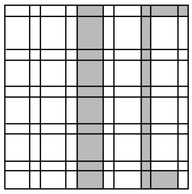
The fraction unshaded is $\frac{3}{4}$



F

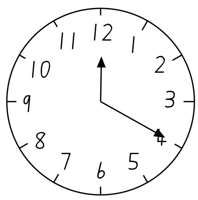


$\frac{1}{4}$ of this shape is shaded. H

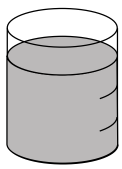


The fraction unshaded is $\frac{77}{100}$ P

20 minutes is $\frac{1}{2}$ an hour.



J

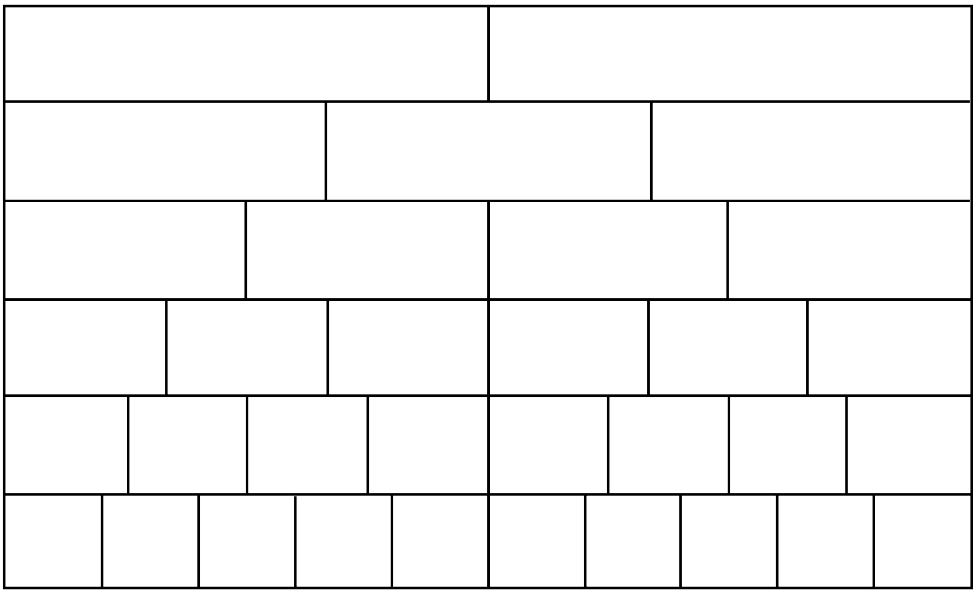


Approximately $\frac{1}{4}$ of the jar is full. K

Resource 15

Shade the fraction

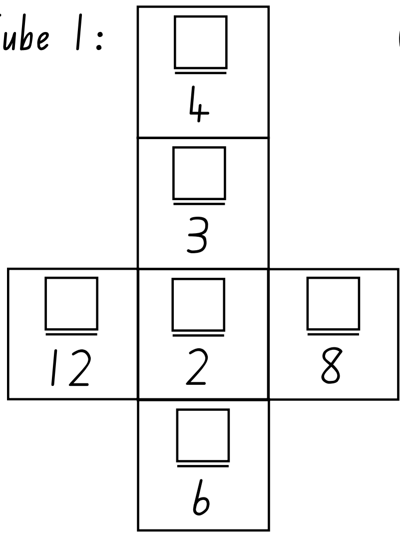
Gameboard:



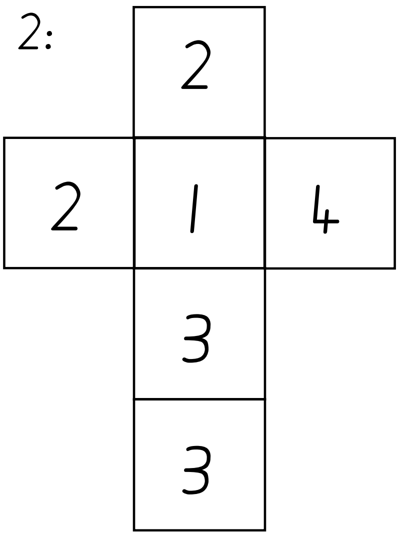
Rules:

1. To start, both pairs roll cube two. Pair with highest number goes first.
2. Roll both cubes.
3. Say the fraction formed out aloud.
4. Shade the fraction strip on the gameboard.
5. All players must agree that the fraction shaded is correct.
6. The first pair completely to shade the fraction strips on the gameboard wins.

Cube 1:

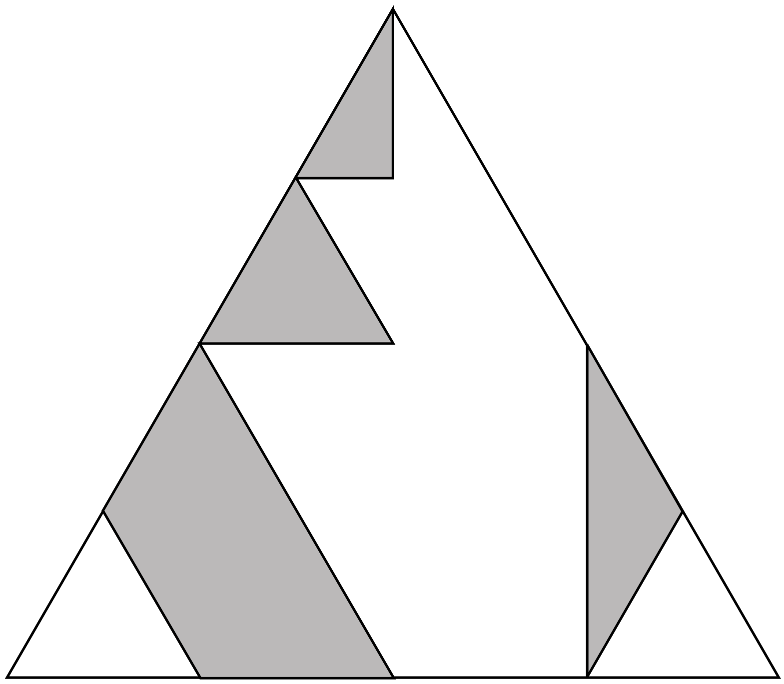


Cube 2:



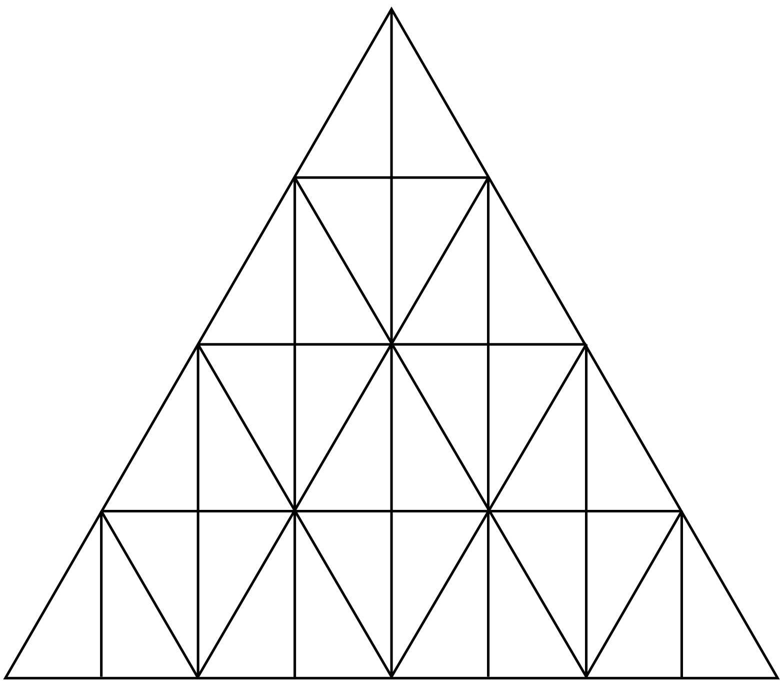
Resource 16

What fraction of the diagram is shaded?



Write up to half a page describing how you were able to answer this question.

Hint: This diagram may be helpful.



Resource 17

Explanation

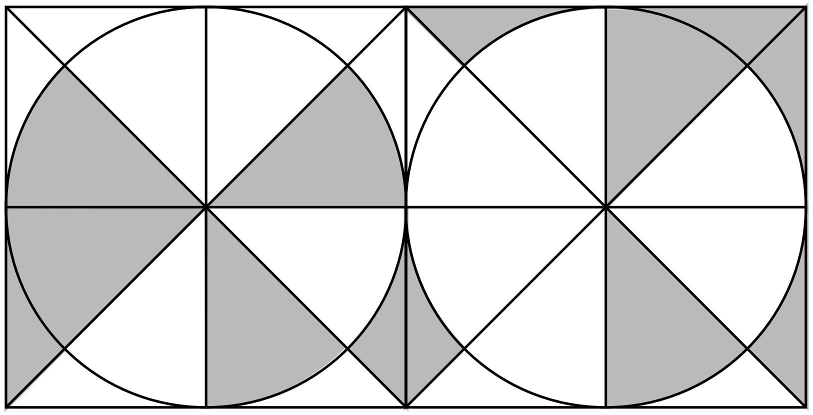
Structure		Example	
Introduce topic or problem to be explained.		Introduce topic or problem to be explained.	The problem is to explain how to find the fraction of the diagram that is shaded.
Series of explanations. (Could involve diagrams, illustrations, mathematics, explaining how to solve the problem)		Series of explanations. (Could involve diagrams, illustrations, mathematics, explaining how to solve the problem)	We started by looking at the hint diagram the teacher provided. The 8cm equilateral triangle was divided into 32 small right-angled triangles of equal size. Tom measured the triangle in the shaded diagram and discovered it was also an 8cm equilateral triangle. Together we discussed how we could calculate the fraction of the diagram that is shaded. Trinh said we should cut out one of the small triangles from the hint diagram and put it in the shaded diagram. The group agreed that this was a good solution until Jelena said "Why don't we just colour the hint diagram to match then shaded diagram?" Then we counted the small triangles we coloured.
Conclusion (answer to the problem)	We found the fraction shaded to be...	Conclusion (answer to the problem)	We found the fraction shaded to be $\frac{11}{32}$.

NEALS

Resource 18

Explanation

What fraction of the diagram is shaded?



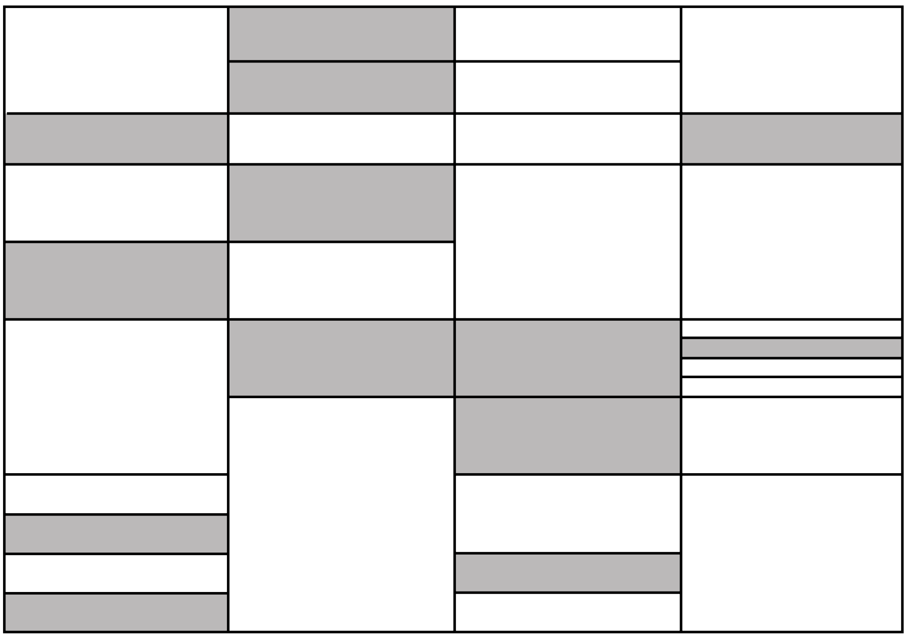
Write up to half a page describing how you were able to answer this question.

Structure	
Introduce topic or problem to be explained.	
Series of explanations. (Could involve diagrams, illustrations, mathematics, explaining how to solve the problem)	
Conclusion (answer to the problem)	

Resource 19

Investigation

What fraction of the diagram is unshaded?



Describe the method used to solve this question.

Unit three: Geometry

Syllabus reference

Year 7-8 syllabus, G1.1: Shapes, G1.3: Properties of common solids (informal treatment)

Outcomes

This unit provides students with the opportunity to:

- name common solids
- manipulate solids in order to determine such properties as:
  - ease of packing and stacking
  - rolling capability
  - number and types of faces
  - number of curved surfaces
  - number of flat surfaces
  - number of equal faces
- make “skeletal” models using straws and pipe cleaners.

Activity 3

$1\frac{1}{2}$ hours

In this "jigsaw" activity, groups of students become involved in different but connected tasks. Each of these tasks supplies a part of what all students will need to know. The students then come together, in a home group, to exchange and share their information enabling them to complete the final task.

Resources

- Information table (resource 20), one for each group.
- Investigation question (resource 21), one for each group.
- Expert group task cards (resource 22), one for each group.
- Information passages (resources 23a to 23f), three copies of each.
- Worksheet (resources 24a to 24f), one copy each.
- A set of 3D models (cylinder, triangular prism, rectangular prism, rectangular pyramid, triangular pyramid and cube), one for each group.
- Plastic straws and pipe cleaners to make skeletal models, enough for one model per student.
- PMI reflection sheet (resource 25), one per student.

Description

- Group students in their "home" groups. Approximately six students per group.
- Describe the jigsaw activity.
  1. Students will leave their home groups and form a number of expert groups.
  2. Each expert group will complete tasks that are different from those of other groups. By completing these tasks they will become an "expert" on one particular solid.
  3. The students will return to their home groups, bringing with them the expert information.
  4. The home group will share all the information, enabling them to complete the final task.
- Display the final tasks to the students (resources 20 and 21 on OHT). Students will be required to complete a table on various solids and then use this information to answer an investigation question.
- Give each student in each home group a number from 1 to 6.
- Students now regroup into expert groups. All ones together, all twos together.

1	2		1	1	2	2	3	3	4	4	5	5	6	6
3	4	→	1	1	2	2	3	3	4	4	5	5	6	6
5	6		1	1	2	2	3	3	4	4	5	5	6	6

1-5 = students
6 = teacher

- Give each expert group their task to complete.
  – Expert group task card (resource 22). This card explains what students are to do.
  – Information passage (resource 23).
  – Worksheet (resource 24), requiring students to complete a vocabulary task and to label a diagram.
- Organise resources (3D models, straws and pipe cleaners) for students to complete their task card.

NB: Teacher could assume the role of expert for one solid and model or demonstrate for students each stage of the jigsaw process.

Activity 3 continued…

- Students are given approximately 25 minutes to complete tasks.
- Students return to home groups, bringing with them the expert information, to complete the final task of compiling the information for the table about the six 3D shapes (resource 20). The home groups then apply this information to write a report on the investigation (resource 21).
- Display reports and models around the room, in the library or at parent/teacher evenings.
- As a conclusion to the activity, have students reflect on the unit of work. A PMI (resource 25) is an efficient way of obtaining this type of student feedback. Simultaneously students are writing about their learning.

Share your expert knowledge to fill in this table (the table can be enlarged to fill an A3 page).

Name of solid	Sketch of solid	Number of flat surfaces	Number of curved surfaces	Number of edges	Number of vertices	Is the shape a prism, pyramid or neither?	Number of equal faces	What is the shape of the base (cross-section)?	Does the shape roll? (Yes/No)	Does the shape stack easily? If yes, draw its stacking
1.										
2.										
3.										
4.										
5.										
6.										

- Students need to ask questions of each other to obtain all information. Every student must participate for the home group to complete its task successfully.

- Students are able to practise their retelling skills.

- When using this strategy for the first time, it may be useful to have a second teacher, parent or ESL support in the room.

- Students take an active role in the reading and learning process. The teacher is a facilitator of learning.

- Students have a high rate of retaining information.

- All readers, both struggling and confident, are given reason and motivation for attempting to comprehend the materials.

- The jigsaw approach adds variety for both teachers and students.

- Previewing the final task to the students encourages them to focus on the required information.

- Teacher needs to check that each expert group understands the information.
- The jigsaw is distinct from other reading activities in that each group has different information. It is only by pooling this information that students can fully understand, and complete, the final task.
- Students take an active role in the reading and learning process. The teacher is a facilitator of learning.
- Students have a high rate of retaining information.
- All readers, both struggling and confident, are given reason and motivation for attempting to comprehend the materials.
- The jigsaw approach adds variety for both teachers and students.
- Previewing the final task to the students encourages them to focus on the required information.
- Students can read the passage quietly at first; then one student can read it out aloud to the rest of the group.

- The 3D model assists students in labelling the 2D representation. Vocabulary and meaning are reinforced.

- Encourage students to add words to the technical vocabulary table.
- When using this strategy for the first time, it may be useful to have a second teacher, parent or ESL support in the room.

Investigation question: Home group

What are the advantages and disadvantages of packaging ice cream in tubs with circular, rectangular or square bases?

Discussion structure

General statement: • state the task • preview arguments to follow	
• Paragraphs on the advantages and disadvantages of packaging ice cream in each type of tub. • Each paragraph begins with a sentence that previews the information in the rest of the paragraph.	
Recommendation:	

Expert group task

1. Read the information about your shape.
   One student could read the information to the whole group or you may like to read it individually.
2. Underline any words you don't understand.
3. Discuss these underlined words with the group to discover the meanings.
4. Complete the worksheet called "Building Technical Vocabulary about 3D shapes". (Work together as a team.)
5. Now label the picture with the geometrical terms listed on the worksheet. (If anyone in your group is having trouble, help them. Don't forget, this is an expert group.)
6. The person with the longest hair in your group needs to collect the model of your shape from the teacher NOW.
7. Pass the shape around the group.
8. The tallest person in your group must now collect the equipment needed to build a model of your 3D shape.
   The model will be built from straws and connectors. We call this type of model a skeletal model.
   Everyone in the group must make a model.
   When you return to your original group you will be the expert on your shape.
9. Congratulations, you are now all experts on this shape and it is time to return to your original group to share your expertise.

STOP! WAIT FOR ALL THE OTHER GROUPS TO FINISH. The teacher will tell you when it is time.

While you are waiting you might like to read through all your information again. Remember: you are the expert now!

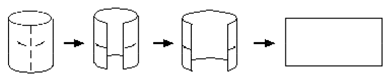
The cylinder

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids, but a cylinder is neither of these.

A cylinder can be open-ended. This means that it has one or two ends opened. Some examples of open-ended cylinders would be a pipe and a can without a lid. An unopened tin is an example of a closed cylinder.

A cylinder has one curved surface. It can also have two flat surfaces if it is a closed cylinder. It has two edges, one goes around the top of the cylinder and one edge goes around the bottom.

The ends of a cylinder are circles that are the same size. If you opened the cylinder out, as in the diagram below, you would see that the curved surface is really a rectangle which has been rolled up.



A cylinder has a cross-section which is circular. This means that if a cylinder was sliced, all the slices would be circles, just like slices from a cylindrical loaf of bread.

A cylinder is a solid that will roll and stack easily. Cans are regularly stacked in shops.

Building technical vocabulary about 3D shapes

Complete this table by:

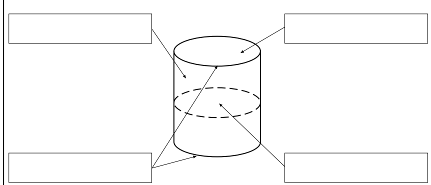
a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand. Find out what these words mean and put this meaning in the table.

Everyday language	Geometrical term (mathematical language)
corners of the shape	
length, width, depth	
shape when you slice it	

Cylinder

Label the parts of the cylinder.



Label the diagram by using these words:

edge	curved surface
flat face	cross-section

Resource 20

Share your expert knowledge to fill in this table (the table can be enlarged to fill an A3 page).										
Name of solid	Sketch of solid	Number of flat surfaces	Number of curved surfaces	Number of edges	Number of vertices	Is the shape a prism, pyramid or neither?	Number of equal faces	What is the shape of the base (cross-section)?	Does the shape roll? (Yes/No)	Does the shape stack easily? If yes, draw its stacking
1.										
2.										
3.										
4.										
5.										
6.										

Resource 21

Investigation question: Home group

What are the advantages and disadvantages of packaging ice cream in tubs with circular, rectangular or square bases?

Discussion structure

General statement: • state the task • preview arguments to follow	
• Paragraphs on the advantages and disadvantages of packaging ice cream in each type of tub. • Each paragraph begins with a sentence that previews the information in the rest of the paragraph.	
Recommendation:	

Expert group task

1. Read the information about your shape..
   One student could read the information to the whole group or you may like to read it individually.

2. Underline any words you don't understand.

3. Discuss these underlined words with the group to discover the meanings.

4. Complete the worksheet called "Building Technical Vocabulary about 3D shapes". (Work together as a team.)

5. Now label the picture with the geometrical terms listed on the worksheet. (If anyone in your group is having trouble, help them. Don't forget, this is an expert group.)

6. The person with the longest hair in your group needs to collect the model of your shape from the teacher NOW.

7. Pass the shape around the group.

8. The tallest person in your group must now collect the equipment needed to build a model of your 3D shape.
   The model will be built from straws and connectors. We call this type of model a skeletal model.
   Everyone in the group must make a model.
   When you return to your original group you will be the expert on your shape.

9. Congratulations, you are now all experts on this shape and it is time to return to your original group to share your expertise.

   STOP! WAIT FOR ALL THE OTHER GROUPS TO FINISH. The teacher will tell you when it is time.

   While you are waiting you might like to read through all your information again. Remember: you are the expert now!

Resource 23a

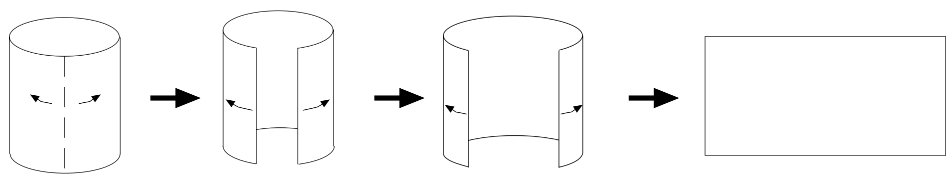
The cylinder

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids, but a cylinder is neither of these.

A cylinder can be open-ended. This means that it has one or two ends opened. Some examples of open-ended cylinders would be a pipe and a can without a lid. An unopened tin is an example of a closed cylinder.

A cylinder has one curved surface. It can also have two flat surfaces if it is a closed cylinder. It has two edges, one goes around the top of the cylinder and one edge goes around the bottom.

The ends of a cylinder are circles that are the same size. If you opened the cylinder out, as in the diagram below, you would see that the curved surface is really a rectangle which has been rolled up.



A cylinder has a cross-section which is circular. This means that if a cylinder was sliced, all the slices would be circles, just like slices from a cylindrical loaf of bread.

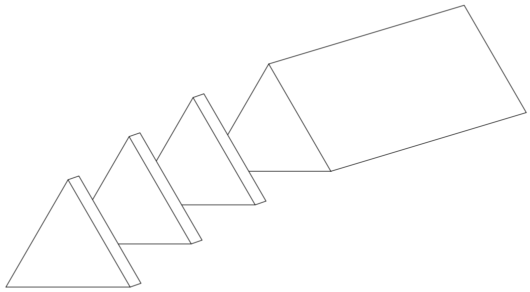
A cylinder is a solid that will roll and stack easily. Cans are regularly stacked in shops.

The triangular prism

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A prism is named according to the shape of its cross-section.

If the triangular prism is sliced as in the diagram below, then each slice is exactly the same shape and size as the ends of the prism. This shape is called the cross-section. The cross-section of a triangular prism is a triangle.



A triangular prism has two triangular faces. The other three faces are rectangles. Two faces meet at an edge. The triangular prism has nine edges. It has six vertices or corners.

This solid does not roll but it could be stacked if care was taken.

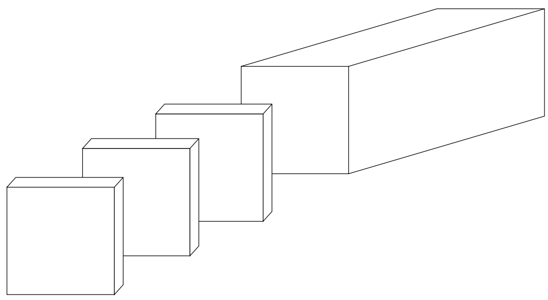
Resource 23c

The rectangular prism

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A prism is named according to the shape of its cross-section.

If the rectangular prism is sliced as in the diagram below, then each slice is exactly the same shape and size as the ends of the prism. This shape is called the cross-section. The cross-section of a rectangular prism is a rectangle or a square.



A rectangular prism has six faces. The top and bottom faces are the same size. The left and right hand side faces are the same size, and the front and back faces are the same size.

A special rectangular prism is the cube. It has six faces which are all squares.

Two faces meet at an edge. Three faces meet at a vertex. The rectangular prism has twelve edges. It has eight vertices or corners. Many boxes you see every day are rectangular prisms.

This solid does not roll but it can be stacked easily.

Resource 23d

The rectangular pyramid

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A pyramid is a solid with a polygon for a base. All the other faces meet at one point. This point is called the apex (it is also called a vertex).

Because pyramids do not have a cross-section they are named according to the shape of the base. The base of a rectangular pyramid is always a rectangle.

A rectangular pyramid has five faces. Four of the faces are triangles. The other face, the base, is a rectangle.

Two faces meet at an edge. The rectangular pyramid has eight edges. It has five vertices or corners. A rectangular pyramid is not seen often in everyday life – unless you live in Egypt !

This solid does not roll and it does not stack on top of another.

The triangular pyramid

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A pyramid is a solid with a polygon for a base. All the other faces meet at one point. This point is called the apex (it is also called a vertex).

Because pyramids do not have a cross-section they are named according to the shape of the base. The base of a triangular pyramid is always a triangle. Another name for a triangular pyramid is a tetrahedron.

A triangular pyramid has four faces. All of the faces are triangles.

Two faces meet at an edge. The triangular pyramid has six edges. It has four vertices or corners. A pyramid is not seen often in everyday life – unless you live in Egypt!

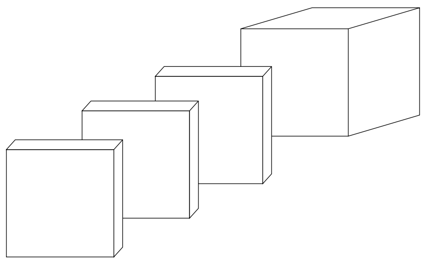
This solid does not roll and it can not be be stacked on top of another.

The cube

Solid shapes are also called three-dimensional shapes because they have three dimensions. The three dimensions are length, width (or breadth) and depth (or thickness). The two main families of solids are called prisms and pyramids.

A prism is usually named according to the shape of its cross-section. A cube is a special prism in that it is a regular solid. This means that all of its faces are the same size.

If the cube is sliced as in the diagram below, then each slice is exactly the same shape and size. This shape is called the cross-section. The cross-section of a cube is a square.



A cube has six faces, which are all squares. Two faces meet at an edge. The cube has twelve edges. It has eight vertices or corners. A die is an example of a cube.

This solid does not roll but it can be stacked easily.

Resource 24a

Building technical vocabulary about 3D shapes

Complete this table by:

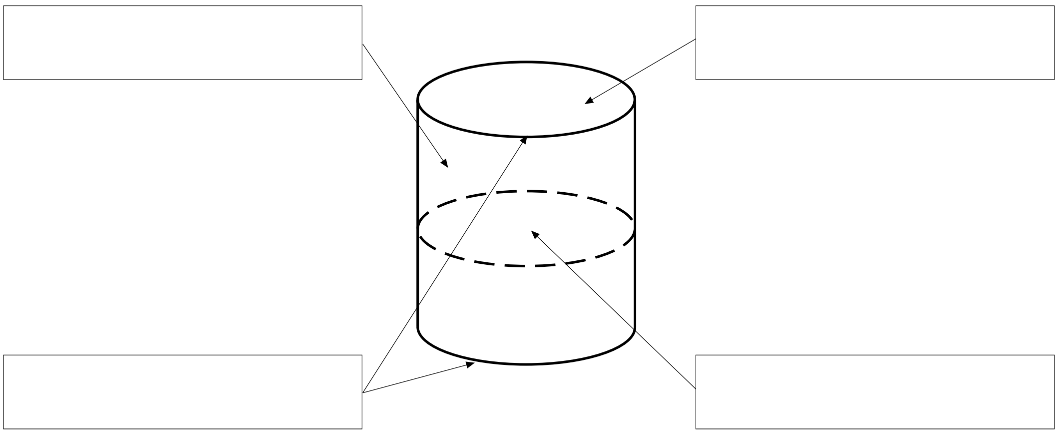
a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand.
Find out what these words mean and put this meaning in the table.

Everyday language	Geometrical term (mathematical language)
corners of the shape	
length, width, depth	
shape when you slice it	

Cylinder

Label the parts of the cylinder.



Label the diagram by using these words:

edge curved surface

flat face cross-section

Resource 24b

Building technical vocabulary about 3D shapes

Complete this table by:

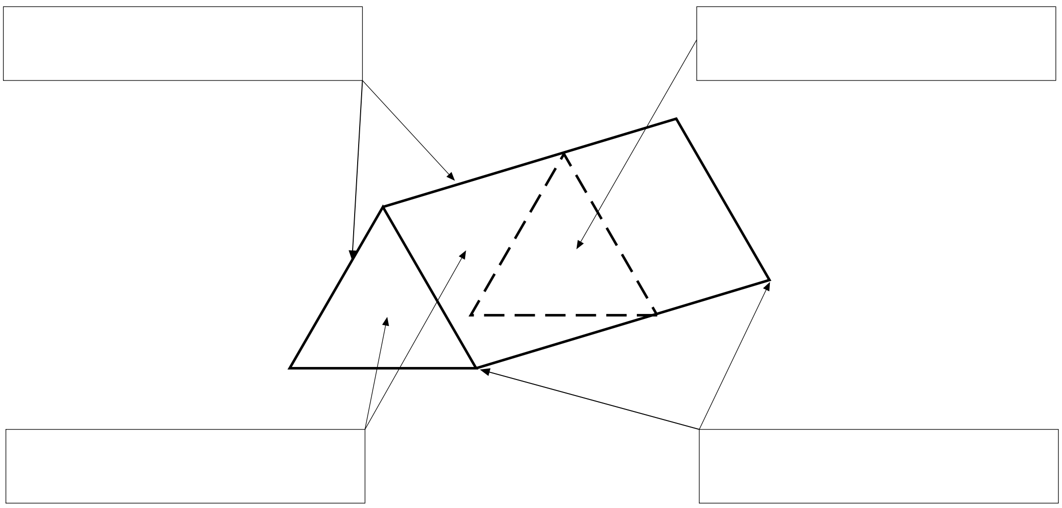
a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand.
Find out what these words mean and put this meaning in the table.

Everyday language	Geometrical term (mathematical language)
corners of the shape	
length, width, depth	
shape when you slice it	

Triangular prism

Label the parts of the triangular prism.



Label the diagram by using these words:

cross-section faces

edges vertices

Resource 24c

Building technical vocabulary about 3D shapes

Complete this table by:

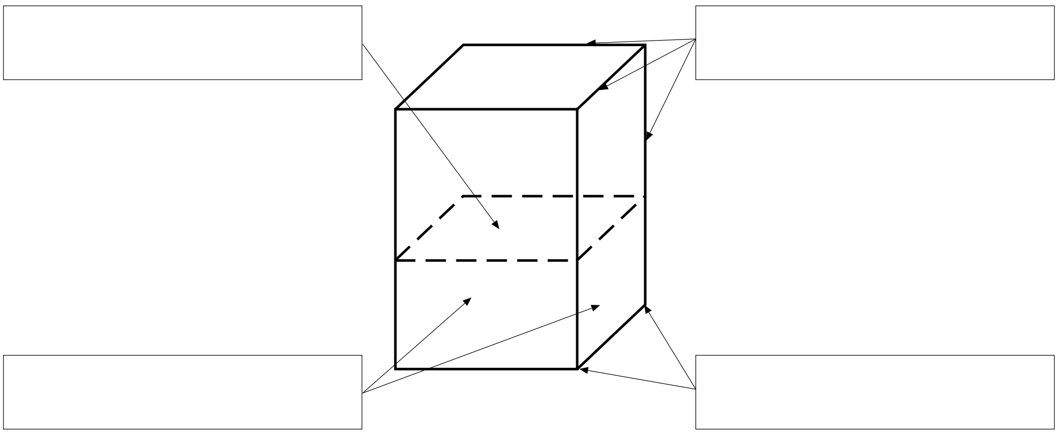
a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand. Find out what these words mean and put this meaning in the table.

Everyday language	Geometrical term (mathematical language)
corners of the shape	
length, width, depth	
shape when you slice it	

Rectangular prism

Label the parts of the rectangular prism.



Label the diagram by using these words:

vertices edges

cross-section faces

Building technical vocabulary about 3D shapes

Complete this table by:

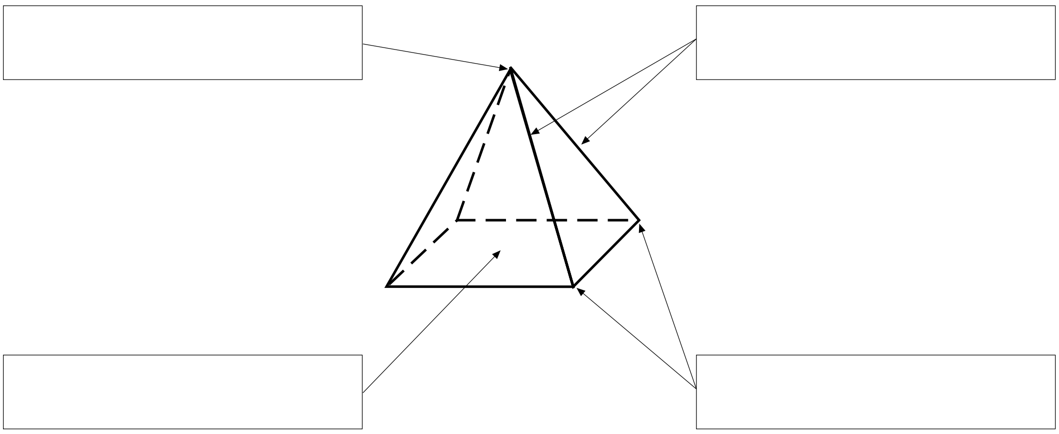
a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand.
Find out what these words mean and put this meaning in the table.

Everyday language	Geometrical term (mathematical language)
corners of the shape	
length, width, depth	
shape when you slice it	

Rectangular pyramid

Label the parts of the rectangular pyramid.



Label the diagram by using these words:

face — edges

vertices — apex

Resource 24e

Building technical vocabulary about 3D shapes

Complete this table by:

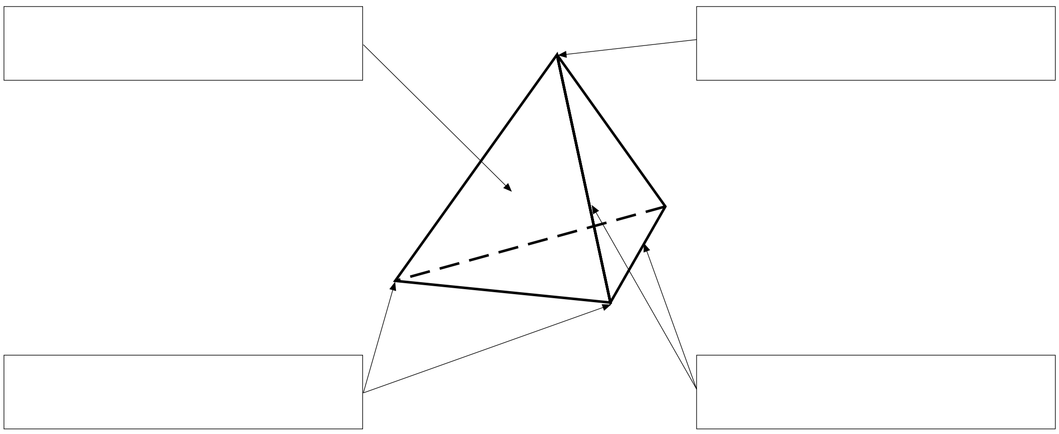
a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand.
Find out what these words mean and put this meaning in the table.

Everyday language	Geometrical term (mathematical language)
corners of the shape	
length, width, depth	
shape when you slice it	

Triangular pyramid

Label the parts of the triangular pyramid.



Label the diagram by using these words:

vertices edges

apex face

Building technical vocabulary about 3D shapes

Complete this table by:

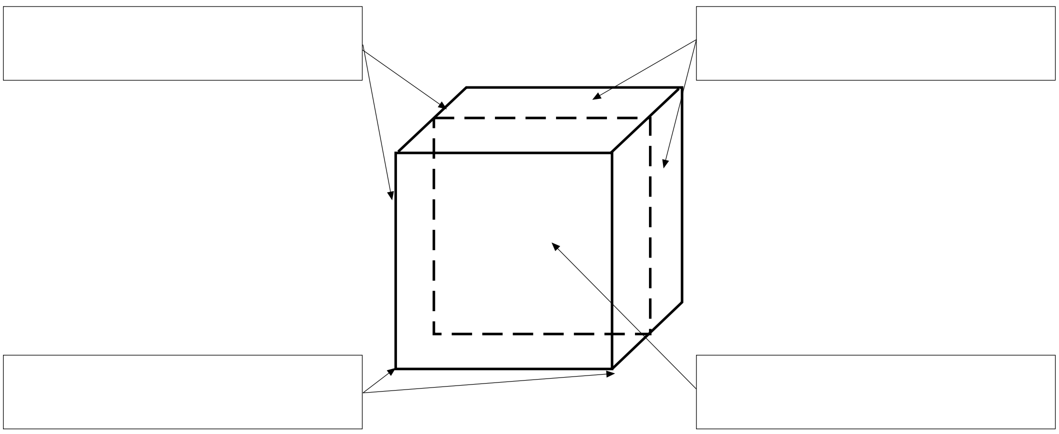
a) filling in the geometrical terms for the words given

b) adding other geometrical words that you do not understand.
Find out what these words mean and put this meaning in the table.

Everyday language	Geometrical term (mathematical language)
corners of the shape	
length, width, depth	
shape when you slice it	

Cube

Label the parts of the cube.



Label the diagram by using these words:

vertices edges

cross-section faces

Resource 25

3D shapes activity – PMI

Plus What did you like?	
Minus What didn't you like about this?	
Interesting What parts of the activitiy did you find interesting? What would you like to know more about?	

Chapter 5: Planning a whole-school approach to literacy

This chapter should be read in conjunction with *Planning a Whole-School Approach to Literacy* (1997), NSW Department of School Education.

Establish literacy as a school priority

At faculty and whole-school meetings discuss and develop understandings about the literacy demands of various KLAs and subjects.

The district literacy team can provide advice to faculty groups on ways to identify and describe these literacy demands.

Focus on Literacy (1997), NSW Department of School Education, makes a useful starting point for meetings and professional development activities related to literacy.

Chapters 1 and 2 of this book describe in detail the literacy skills, knowledge and understandings which students in Year 7 need to demonstrate in order to be successful.

Having established an understanding of the literacy demands of each subject, teachers should then examine their teaching programs to identify opportunities for systematic and explicit literacy instruction.

The literacy support team in the school may assist in highlighting opportunities to develop students' literacy skills in each subject. Support teachers, such as ESL teachers, STLDs and teacher-librarians, should be involved in providing advice about specific strategies.

The school needs to recognise the value of a whole-school approach to literacy and ensure it becomes part of the school management plan. Ways of meeting the professional development needs of individual teachers and faculty groups should be included in the plan. Teachers could be surveyed to establish their current knowledge and expertise. *Planning a Whole-School Approach to Literacy*, Appendix 1, is an example of a survey.

Sample survey from: *Planning a Whole-School Approach to Literacy*, Appendix 1.

[illegible]

Name: ____________________

[illegible] *range of contexts*.

1. List any formal training qualification in literacy

(a) Preservice

____

(b) Inservice

____

2. Do you have any other relevant training that could be useful in the literacy area at this school? e.g. public speaking, writing, acting, computing…

____

____

3. [illegible] others in the work place.

____

____

____

4. [illegible] a component? If so, please list.

____

____

____

5. List any literacy resources and/or strategies of which you are aware that could be used to benefit teachers and students at this school.

____

____

____

6. What classroom literacy activities do you use in your classroom?

Sometimes	Often	Regularly

(a) What literacy programs or strategies do you think have been successful at this school?

____

____

____

(b) Why?

____

____

____

8. (a) What literacy programs or strategies do you think have not been successful?

____

____

____

(b) Why?

____

____

____

[illegible]

Determining priorities within the plan

In order to plan an appropriate literacy plan for the school, information about students' current literacy achievements needs to be analysed. The ELLA results can provide useful information about individuals' and cohort groups' strengths and weaknesses. An analysis of the areas in which students require additional support will indicate a focus of the plan. Other information may be gathered by analysing School Certificate and Higher School Certificate results. Data gathered by teachers through informal and formal assessment tasks will also highlight areas needing support. Having collected and analysed all available data, the staff should determine priorities within the school plan. These priorities should also reflect the State Literacy Strategy.

Developing outcomes for the school plan

These priorities should then be translated into outcomes for students and teachers. These outcomes need to be written in language which is explicit and defines precisely what is to be achieved. Some outcomes will relate to short-term achievements while others will be long-term. A short-term goal may be that all teachers have been trained in the NPDP modules, *Literacy across the KLAs, Years 7 & 8*. A long-term outcome may be that increased numbers of students take three level courses.

Some of the goals will have implications for teachers' professional development, and this will need to be documented in the plan, including what form the professional development will take, how it will be provided and how it will be funded.

Resourcing the school plan

Collect information about available resources, both human and material. This will include the expertise which already exists within the staff and the district. It will also include surveying and collecting information about literacy programs which are already in the school. Appendix B in *Planning a Whole-School Approach to Literacy* offers one way of doing this. Determine which programs are achieving their outcomes and are aligned with the outcomes of the school plan.

Decide whether additional resources will be required to achieve the outcomes of the school plan. If additional human resources are needed, how will these be found?

Will it require a more flexible organisation of the school timetable? If additional material resources are required, how can these be budgeted for in the school plan? Ensure that all staff have the opportunity to provide input to the resourcing of the plan.

Informing parents and the community

Parents and community members could be involved in developing the school plan. Participants could be drawn from the Parents and Citizens Association, local community groups or parents who express a particular interest. All parents and caregivers should be kept informed of the development and progress of the plan through meetings and newsletters. It may be necessary to provide this information in a range of community languages. When reporting on student achievement, each KLA should include information about literacy achievements and indications of areas requiring additional support. The nature of the support being supplied by the school should be indicated. To do this teachers will need to include literacy achievements in the criteria they apply to assessing students' work and have a plan in place to assist those students who are experiencing difficulties.

Evaluating the plan

Mechanisms for evaluating the overall success and the outcomes of the plan should be established and written into the plan. For long-term outcomes, indicators may need to be established to ensure that the school is working purposefully towards the achievement of those outcomes.

Case study

The following case study provides an example of how one school set about establishing a successful literacy plan.

Fairfield High School (FHS) is a large comprehensive high school located in the south-western suburbs of Sydney. It has approximately 1400 students, of whom 97% are from a non-English speaking background. This represents 68 different nationalities. FHS is on the Disadvantaged Schools Program, indicating that the majority of students are from a low socio-economic status background.

An Intensive English Centre (IEC) with 120 students is attached to the school. The IEC students have come to Australia, often as refugees from war-torn countries, with little or no English language skills. Schooling for these students has often been severely disrupted, with many of them having only two or three years of primary school. Some students are illiterate in their first language.

In 1991 it was evident that the literacy skills of students leaving the IEC to undertake senior studies were inadequate to cope with HSC courses, particulary those which required reasonable writing skills. The mathematical skills of these students, however, were often quite sound. It was realised that strategies needed to be developed to improve their reading, comprehension and writing skills. In response to these needs, a course was developed to enable these students to bridge the gap between the IEC and mainstream schooling.

The mathematics faculty worked closely with ESL teachers to develop literacy activities and teaching strategies aimed at improving students' literacy competencies in HSC mathematics courses. Activities such as card matches, sequencing and barrier activities, were incorporated in student-centred, cooperative groupwork situations. These activities proved to be so successful in stimulating student discussion and the effective use of mathematical terminology that they were trialled in other classes. It was soon evident that these strategies were effective in improving mathematical literacy for all students.

Through a DSP submission (1992-94) the school was able to obtain funds to provide the time needed to create, develop and trial new resources. Professional development was inherent. In 1992 the submission focused on the development of literacy strategies for Year 7. Each following year the focus was widened; in 1993 both Years 7 and 8 were the focus. This was successful for the school because:

- it enabled the achievement of a realistic goal
- Year 7 students were more receptive to group work because of their primary school experiences.

To support these new approaches to teaching mathematics FHS targeted the parents of the incoming Year 7 students. Parent information evenings were held annually, giving parents and their children the opportunity of becoming actively involved in a variety of Year 7 mathematics lessons. These evenings were extremely successful.

> "I came to this parent workshop with the expectation of being lectured at for two hours. However, I really enjoyed the algebra lesson with the blocks. If they had taught like this when I was at school I might have understood it" (Year 7 parent, 1992).

Keeping the parents well informed about current teaching methods can support the implementation of programs. Information about mathematics was regularly communicated to the parents through faculty newsletters, which were issued on a term basis.

The activities initially developed could also be used in other year groups. As teachers and students became more comfortable with this style of teaching, new activities were made and trialled for all year groups. The submission provided time for the continual professional development of staff through faculty days and faculty meetings. These fostered enthusiasm and maintained high motivation for the development of literacy skills in our classrooms.

Over the last six years the mathematics faculty has developed three filing cabinets full of inexpensive activities. These have been filed in program order for Years 7 to 12. All faculty members contributed to the development of resources. Most of the activities were prepared using coloured photocopiable cardboard, elastic bands and plastic sleeves. Many ideas are derived from textbooks: adapting questions into card matches or squaresaws, and worked examples into sequencing activities.

Other sources of new ideas came from:

- mathematics journals and publications
- networking within the school and with other schools
- contact with university teacher education personnel
- involvement with mathematical associations, both local (Liverpool Maths Teachers Association) and state (Mathematical Association of New South Wales).

Through DSP and the school training and development programs, other faculties have acknowledged the value of the mathematics staff's literacy strategies, and consequently have adopted many of them.

Change is a slow process. Both students and teachers need to come to terms with any dramatic change of routine. The fear of failure and of losing control in the classroom deters some teachers from taking risks. Not all of the activities trialled were successful. It is vitally important to be able to discuss successes and failures with colleagues and to share implementation strategies.

The mathematics faculty found the following points critical in establishing a literacy focus:

- sharing resources and ideas
- being prepared to take risks (you really need to have a buddy to share successes and failures)
- starting small: pairs, small group then large group activities
- encouraging teachers' suggestions for new ideas and strategies. Most ideas can usually be adapted to meet the students' needs.
- capitalising on the enthusiam of interested staff
- recognising that there is still a place for the more traditional methods of teaching. Chalk is still allowed in our classrooms!
- acknowledging that the teacher's role should be one of facilitating learning.

The FHS mathematics faculty is continuing to develop new teaching resources and strategies to assist students in their literacy development in mathematics. As a result of this faculty focus, students have acquired a more positive attitude towards mathematics. Classrooms are filled with students communicating mathematically (discussions, problem-solving, arguing a point). Students feel more comfortable with expressing concerns about their learning.

Where to from here?

The faculty's future directions lie in the area of assessment, literacy strategies for investigations and primary links. Through the Middle Schools Project and DSP, links between Fairfield Public School and Fairfield High School have been strengthened. Years 4 to 6 students from Fairfield Public School attend at least one mathematics lesson throughout the year. The aim is to facilitate a smooth transition from primary to high school, develop staff professionally and coordinate the sharing of information about students' levels of achievement.